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Contributions.

The Justifiable Expenditure for Improvement in the Alignment of Railways.

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REDUCTION OF LENGTH.

We may premise that the increase in operating expenses caused by the adoption of a longer line is by no means a constant quantity per unit of length, although often assumed to be. In the first place, a longer line may be adopted either for the purely engineering purpose of securing lower grades or lighter work; or, secondly, for the commercial purpose of thereby securing a larger way business. In the latter case, we have, in addition to the same purely engineering questions as before, the further question of the capitalized value to the line of such additional way business. It is with the former case only that we are directly concerned, but even in that case the value of a mile saved is by no means the same whether the total saving be one mile or twenty. The number of yearly trips of rolling stock, number of stations and sidings, etc., and the considerable class of expenditures which vary with those items, remain nearly constant under the small changes of distance, which most frequently occur, and are not perceptibly affected until the change of length amounts to a considerable percentage. How much the expenses are increased by such relatively small changes of length we will first endeavor to determine, by examining separately the various items of expense; premising that this must be done in some detail if the conclusions are to possess any value, and that it is better to err, if at all, by underestimating the increased expense due to unfavorable alignment, in order that all extra outlay on construction may be fully justified.

Fuel and Oil.—A very considerable percentage of the consumption of fuel is a constant wastage, nearly independent of the exact distance run. The cost of kindling fires only averages about 10 per cent. of the cost of fuel on the Philadelphia & Reading Railroad as shown in Table IX below. Mr. Russell

TABLE IX.

Showing the Relative Cost of Wood for Kindling on the Philadelphia & Reading Railroad for a Series of Years.

YEAR.	Percentage of the cost of kindling wood to remaining cost of fuel.			Prices of fuel.		Average consumption of Wood for kindling.
	Passenger trains.	Freight trains.	Coal trains.	Wood per cord.	Coal per ton.	
1867....	14.2	10.	5.1	\$5 79	\$3 16	Passenger trains, .13 c'd.
1868....	8.8	6.4	3.6	5 50	3 80	Freight " .15 "
1875....	9.7	6.3	4.1	5 94	8 25	Coal " .22 "
Average	10.9	7.5	4.3	\$5 74	\$3 40	

REMARKS.—The above does not include the cost of any coal used in kindling. The consumption of wood seems very small; Mr. Trautwine (Engineers' Pocket Book, p. 411) gives $\frac{1}{4}$ cord as the average consumption. When this road was using wood fuel entirely, passenger trains used 2.7 cords per 100 miles, or about 2½ cords per daily run of 93 miles. Allowing $\frac{1}{4}$ cord for getting up steam would amount to exactly 10 per cent.

Sage, Jr., in an article in *Van Nostrand's Engineering Magazine* for 1873 says: "I am assured that a dead engine cannot be fired up for less than \$2.00." This would amount to nearly 20 per cent. of an average cost for fuel, and is probably an excessive estimate; but information from various sources which the writer has been able to secure indicates that this expense averages about 10 per cent. of the cost of fuel. The consumption due to stopping and starting and to standing idle in yards and on side tracks is also a heavy item, and may be considered as nearly independent of distance in the case of two nearly equal lines operating under the same conditions between the same termini. The direct loss of power in stopping a train running at a speed of 25 miles an hour would be sufficient to run the train over a mile; and, as to the wastage while standing idle, the writer is informed that a saving of 10 or 15 per cent. has been observed on the New York Central Railroad since freight trains are partly relieved from this expense by independent freight tracks. These two sources of waste combined may be estimated at 20 per cent., or, including 10 per cent. for firing up, we have a total of 30 per cent. as a wastage independent of a slight change more or less in the length of the run. At least one-half of the cost of oil, waste and water is similarly independent of distance.

Repairs of Engines and Cars.—Such portion of this expense as is due to making up trains, stopping and starting, loading and unloading, and to the effect of time and age is nearly independent of minor variations in length. The extent of the deterioration from these causes, in distinction from the regular running wear is purely a matter of opinion; the writer has heard it variously estimated at from 1-5 to ½. Thirty per cent. would seem a moderate estimate, or, of the total cost of 19 per cent. for these items we may say that 14 per cent. only is due to the regular running wear while in motion.

Train Wages.—This expense is practically independent of very small variations of length, and when the train hands are

paid by the day or month, is even independent of changes of several miles. On most railways, however, the engine crew is paid by the mile, and, on an increasing number, all train hands are so paid without distinction. For changes of length of less than half a mile it may properly be omitted altogether, and for greater changes it may be allowed for, if necessary, by increasing the estimate for small distances, by a proper percentage, as will be done below.

Maintenance of Way.—The cost of yards and structures is practically independent of small variations in length, since the number of stations, important bridges, etc., will be probably the same on any two alternate lines, or will even be less on the longer line, as a rule, for obvious engineering reasons. The remainder of the cost of maintenance of way, however, including all track and road expenses, may be considered as varying directly as the distance.

Station Expenses and Taxes.—Since taxes are based upon value, and a short line is worth more than a long one between the same points, taxes may be said to be independent of, if not inversely as, the length. Station and general expenses also are practically independent of variations in length, unless the volume of business is also affected, which is outside of the purely engineering question.

Summing up these items, we have, as the cost per train-mile of minor changes of distance:

	Total cost of item at \$1 per train-mile.	Proportion of same increasing with distance.	Cost of running on one additional mile.
Fuel.....	10 cts.	70 per cent.	7 cts.
Oil, waste and water.....	3 "	50 "	1 "
Repairs of engines and cars....	19 "	70 "	14 "
Train wages.....	12 "	unaffected by small changes, all but yds and structures, unaffected.	.....
Maintenance of way.....	27 "		20 "
Station and general expenses..	30 "		.....
Total.....	\$1.00	42 per cent.	42 "

In other words, the cost per mile of additional distance is only about 42 per cent. of the average total cost of a train-mile, in the case of such minor changes of length as do not appreciably increase the expense for train wages. At what distance such increase begins is a question for settlement in each case. The percentage by which the above estimate must be increased, for more considerable changes of distance, we shall consider below.

Expressing the above cost per train mile in terms of the yearly cost per daily train: In a year there are 313 week days. Making some allowance for Sunday and incidental business, we may say that each daily train will represent on an average 325 round trips yearly over the line, hence the cost per year per daily train of one additional mile will be— $\$0.42 \times 325 = \137 (i. e., 273 times the average cost of a train mile). From this we have, as the cost per year of one additional foot, $\$137 \div 12 = \11.42 (i. e., about 5 per cent. of the average cost of a train mile).

These sums, divided by the rate of interest on the capital (.06, .07, &c.), give the capitalized value of saving one foot and one mile of distance which is given in the first column of the table (Table A) below.

In the case of projected improvements in the alignment of railways already in operation, we may more conveniently estimate the value of distance on the basis of the average annual expenditure per mile of road, either in the aggregate or, more correctly, that for the affected items only. For this purpose, we may express the cost of operating one additional mile of distance in any one of the following ways: the relative accuracy of each being as it includes all those items which are affected and excludes all those unaffected. An estimate on the basis of the total expenditures per mile is thus the most inaccurate of all.

The yearly cost of operating one mile more or less is 42-100, or 0.42 times the average yearly TOTAL EXPENSES per mile.

42-70, or 0.6 times the average yearly "transportation" or "line" expenses per mile.

42-23, or 1.826 times the average yearly maintenance of road-bed and track expenses per mile.

42-31, or 1.355 times the average yearly cost of fuel, oil and repairs of engines and cars per mile.

42-37, or 1.135 times the average yearly cost of fuel, oil, repairs of engines and cars, and engine wages per mile.

The amounts, or percentages, last given above, multiplied by the yearly expenditure per mile for the item opposite to it, give the total yearly cost per mile of operating additional distance, and divided by the rate of interest on capital, give the capitalized value of saving distance. We thus obtain (dividing by 5,280 for the value of one foot) the last four columns of Table A.

THE COMPARATIVE VALUE OF GREAT AND SMALL REDUCTIONS OF DISTANCES.

As we have before stated, the value per mile of saving distance is not a constant quantity. When the saving of distance is more considerable than we have been previously considering, or at some point varying from 1 to 5 or 10 miles, according to the practice of the road in respect to the standard for train wages, the cost of that item will be affected in proportion to distance. For such considerable changes, also, the cost of switches and sidings and the constant wastage of fuel from standing idle or side tracks may be considered as somewhat increased. Allowing one-third of the cost of switches and sidings (or 1 per cent. of the total expenses) as varying with such increase; and also one-third of that portion of the cost of

fuel which we have previously regarded as constant, we have as the increased value per mile of a considerable saving of distance over a minor one:

Train wages.....	12 cents per train mile
Fuel.....	1 " " "
Switches and sidings.....	1 " " "

Total..... 14 cents per train mile

The value of small distances saved we found to be 42 cents per train mile, or 42 per cent. Hence we may say that a saving

of several miles is worth — or 33 per cent. more per mile than

a minor one, and the values given by Table A should be increased by that percentage. If a portion only of the cost of train wages is considered as affected, the percentage should of course be proportionally reduced.

For very large and considerable differences of length, amounting to 15 or 30 miles in 100, the value of saving distance

TABLE A.

SHOWING THE CAPITALIZED VALUE PER MILE AND PER FOOT OF SAVING SHORT DISTANCES, NOT AFFECTING THE COST OF TRAIN WAGES; ASSUMING A TOTAL COST PER TRAIN MILE OF \$1.00.

RATE OF INTEREST ON CAPITAL.	PROJECTED LINE.		RAILWAYS IN OPERATION.			
	For each estimated daily train (round trip) over the line.	For each estimated \$1,000 of yearly expenditure per mile.	Multiply the average annual expenditures per mile for any one of the following items, by the number given below it, opposite the proper rate of interest.			
			(1)	(2)	(3)	(4)
			All "transportation" or "line" expenses.	Repairs rolling stock and fuel, oil, &c.	Maintenance of way (except bridges and buildings).	Motive power (including wages) and repairs cars.

VALUE OF ONE MILE.						
5 per cent.....	\$5,460	\$5,400	12.	27.1	36.5	22.7
6 ".....	4,550	7,000	10.	22.6	30.4	18.9
7 ".....	3,900	6,000	8.6	19.4	26.1	16.3
8 ".....	3,410	5,250	7.5	17.	22.8	14.2
10 ".....	2,790	4,200	6.	13.5	18.3	11.3

VALUE OF ONE FOOT.						
5 per cent.....	\$1.03	\$1.60	.0023	.0051	.0069	.0043
6 ".....	.86	1.33	.0019	.0043	.0058	.0036
7 ".....	.74	1.14	.0016	.0037	.0050	.0031
8 ".....	.65	1.00	.0014	.0032	.0043	.0027
10 ".....	.53	.86	.0011	.0026	.0035	.0022

YEARLY COST OF ONE ADDITIONAL MILE.....						
	\$273	\$420	0.6	1.355	1.826	1.135

YEARLY COST OF ONE ADDITIONAL MILE.....						
	\$0.0517	\$0.08	.000114	.000257	.000346	.000215

REMARKS.—If the cost per daily train be higher or lower than \$1.00, the value PER DAILY TRAIN given above must be multiplied by that assumed cost. For any saving great enough to decrease the cost of all train wages per trip, the values given above must be increased by a maximum of 33 per cent., and for very considerable distances sufficient to increase the number of daily or yearly trips over the line by a maximum of about 60 per cent.

may properly be still further increased, up to the figures at which all saving of distance without distinction is very commonly estimated, to the serious loss of many railway companies from unjustifiable expenditure, as the writer feels compelled to believe. The conditions of the question are then totally changed. The number of daily or yearly trips which the rolling stock and employees can make over the line will then be increased nearly in proportion to the reduction of distance and their number can be correspondingly diminished, whereas they otherwise cannot. Hence all train expenses and the entire cost of maintenance of way may be considered as varying directly with the length. Station, terminal and general expenses, however, would be very little affected, the volume and character of business being always supposed to be the same.

The total amount of the transportation expenses, or the sum of train expenses and maintenance of way, we have estimated at 70 per cent., or 70 cents per train mile, or 28 cents greater than our estimate for minor differences of length, (42 cents), used in constructing Table A; and strictly in accordance therewith the values given in that Table should be

increased by — or 57 per cent. But as all experience seems to

indicate that even direct train expenses cannot be reduced in practice in direct proportion to distance, although it may appear that they should be in theory, even if the saving were as much as one-half, 50 per cent. instead of 57 is probably an ample if not excessive estimate.

The limits of distance which should fix these several values in either direction are of course very indeterminate, and will vary in each particular case; but the values of Table A may be regarded as nearly constant for the minor changes which are of most frequent occurrence in location, and 50 per cent. increase therefrom as a nearly constant maximum for the most considerable changes.

THE EFFECT OF WAY BUSINESS ON THE VALUE OF SAVING DISTANCE.

The receipts from through business and a portion of the way business are usually (but not always) fixed by competition, and hence quite independent of the exact distance hauled; but a certain large proportion of the receipts of all railway companies is from way business, and in many instances the receipts

* It is usually taken, in round numbers, at $\frac{1}{2}$. E. g., Vose's "Manual for Railroad Engineers," quotation from Mr. Trautwine, foot note to p. 46.

from a part or all of this business are, either by law or custom, fixed by the mile. This fact, if there be any proportion, however small, of such business, is an element entitled to consideration in determining the value of a proposed saving of distance. So far as it is entitled to weight it evidently operates to reduce the value of any such saving.

The following table (Table X.) shows the average paying load per train in several different states and on separate railroads; and also, where the statistics could be ascertained, the percentage which local or way business forms of the aggregate:

TABLE X.

Showing the average paying load of trains and the average proportion of local business for several States and individual Railroads.

Name of State or Railway.	Date of Report.	Average Load of Trains.		Per cent. of local business to aggregate business.
		Passengers.	Tons Freight.	
New York.....	1874	60.	102.3	
Massachusetts.....	1876	69.	65.	(42. (fr't)
Connecticut.....	1874	75.	65.	71. (pass'r)
Ohio.....	1874	61.	65.	
Michigan.....	1873-4	42.	68.	71. (freight)
	1873	49.	...	
L. S. & Mich. So.....	1874	72.5	147.5	80. (freight)
N. Y. Central.....	1874	79.	139.	
Erie.....	1874	49.5	105.	
Pennsylvania.....	1873	58.	110.	65. (freight)
Louisville & Nashville....	1874	34.6	90.	(48. (pass'r)
Phila. & Reading.....	1873	54.	91.	57. (fr't)

REMARKS.—On Lake Shore & Michigan Southern, only freight from Buffalo to Chicago is classed as "through." On the other hand, the Louisville & Nashville includes only way or local business proper as "local," excluding a large amount of business which would ordinarily be classed as local.

Judging by the indications of Table X. it is a low estimate to assume 60 passengers or tons of freight as the average load of a train; and it is also a low estimate to assume that the receipts from that portion of the way business on which the receipts are limited solely by the mile, or the will of the company, is at least one-half of the aggregate and generally more. Assuming an average rate on such business of 8 cents per mile, this gives us at least 90 cents per mile per train as the average receipts from such business.

Considering now the effect of these facts on the value of gaining distance, we have already seen that the cost of running an extra mile averages from 42 to 56 cents, if we assume an average cost per train mile of \$1.00, or from 42 to 56 per cent., whatever the average cost per train mile. This includes all expenses for running such distance, and any additional receipts therefrom must be credited against it in full. Accordingly we see that where way rates are either by law or by fixed custom, determined purely by distance, any reduction of distance would be almost certain to entail a balance of loss upon the company amounting to some cents per train for each mile saved. For example, it would undoubtedly entail a net loss upon the New York Central Railroad, so far as passenger business is concerned, to shorten their line by several miles, even if it could be done without cost to them, provided all their business, both through and way, had to be transacted over the new line. For, estimating the cost of a train mile on that road at \$1.27 and taking 54 per cent. of the same, we have 69 cents as the cost of running a train an additional mile. On the other hand, taking an average load of passengers at 140, and assuming the very low proportion of one-half only, as that on which the receipts are fixed by the legal limit of 2 cents per mile, we have an average gross loss of 140 cents per train, or a net loss of 71 cents, for every mile cut out from the line. And if the gross loss had been but 10 cents instead of 140, it would have operated to reduce the value of any saving of distance by so much, although not entirely destroying it.

It is open to question how much weight should be given to these considerations even where rates are fixed purely according to distance; certainly it should not be so great as the bare facts might appear to justify. As a question of public policy they have no force whatever, the ultimate loss from a needless service being the same whether borne by the railway company or transferred by it to the public. And inasmuch as the prosperity of a railway is intimately connected with that of its supporting population the policy, under any circumstances, of thus inflicting an unnecessary tax upon the community for the sake of a small margin of profit may be questioned, especially as the ability to do so, through absence of competition, is by its very nature temporary and changeable. Nevertheless, as a railway is a business enterprise and not a charitable institution, it may be policy to assign some weight to this consideration, at least to the extent of carefully avoiding an over estimate of the value of saving distance. There are very few roads on which the necessity of fixing rates according to the distance hauled is not practically operative to some extent, even if rates be not so fixed by law; and on many such the whole business of the road is practically independent of competition, while at the same time the future returns on the capital invested are at the best exceedingly problematical. In all such cases a sound policy would seem to require that the expenditure should be mainly directed, not to securing the "shortest line," but to reducing the gradients or vertical distances, which we shall find to be out of sight ahead of linear variations in their effect on operating expenses, but over which a railway company can under no circumstances derive additional revenue for running its trains. A discriminating public is far less willing to pay for transportation over a ravine or a mountain than for being carried ten miles around it.

FRACTIONAL EXAMPLES OF THE VALUE OF DISTANCE.

As an example of the use of Table A, let us take one given in Prof. Vose's "Manual for Railroad Engineers," viz.: What is the value of saving one mile of distance to a road of which the total expenses for maintenance and operation are (or are

expected to be) \$10,000 per mile; cost of capital 6 per cent. Here we have, by the second column of Table A,

$$\$7,000 \times 10 = \$70,000$$

as the value of saving one mile. Or, if we consider the wages of all train hands to be affected *pro rata* by so small a reduction, this amount should be increased by something less than 20 per cent., and we have

$$\$70,000 \times 1.20 = \$84,000,$$

which is the justifiable excess of expenditure to construct an alternate line of any length one mile shorter than the other; and this without allowing any weight to considerations of the effect of way business.

As given in the "Manual," the justifiable expenditure to effect this saving is \$206,666, an excess of from 130 to 200 per cent. over the estimate above.

The writer conceives this rather gigantic difference to be due to two errors in the "Manual." First: In assuming (as is done throughout the chapter on location) that to operate an extra mile, more or less, costs as much as the average expenses per mile, instead of from 42 to 54 per cent. only, if our premises be sound; which accounts for from \$80,000 to \$100,000 of the difference; and secondly, in adding in an imaginary saving due to not constructing the mile saved, which accounts for the remaining \$40,000. But it is very obvious that if we spend it we do not save it. By Prof. Vose's rule, a light, cheap railway doing the same business as a very costly one is not justified in expending the same sum for a given improvement, which is a reduction to absurdity. The author seems to have been naturally appalled by the magnitude of his own figures, for he adds, "in most cases it certainly is not advisable to make so great an expenditure in the beginning as the above figures would indicate." But why not, if the premises be sound and the facts as stated? The outlay which is advisable is the very fact to be determined.

In commenting on this example the author also adds: "In estimating the amount to be spent in reducing grades or curves we are of course to regard their effect on the cost of operation, the same as for simple distance, but the interest on construction, which applies to distance, does not apply to grades and curves." The writer regards this distinction as entirely non-existent, the interest in construction not applying in either case. Whether alternate alignments differ vertically or horizontally, it is the capitalized yearly saving alone which represents the value of one over the other; the cost of construction, balanced against this value then enters in only for the purpose of determining whether it will cost more than it is worth.

As a second illustration: What is the value to the Pennsylvania Railroad Company of cutting out one mile of their main line? This must be different at different points on the line, but we will take an average of the whole line. The expenditures for the past six years have been very nearly uniform at an average of something less than \$26,000 per mile, out of which

All transportation expenses have been about..... 69.7 per cent., or \$18,120 per mile.
Repairs of rolling stock and fuel, oil, etc., have been about..... 33.5 " " 8,720 "
Maintenance of way (except bridges and buildings) has been about..... 21.75 " " 5,660 "
 motive power and repairs of cars have been about..... 35. " " 9,880 "

Then, by Table A, estimating on the basis of all transportation expenses, as the most accurate, we have, as the true value of saving one mile, assuming the rate of interest to be 6 per cent.,

$$\$18,120 \times 10 = \$181,200.$$

Determining the same value by some of the other less exact methods in Table A, for purposes of comparison, we have:

(2) Repairs of rolling stock and fuel, oil, etc..... $\$8,720 \times 22.6 = \$197,072$
(3) Maintenance of way (except bridges and buildings)..... $5,660 \times 30.4 = 172,064$
(4) Motive power (including wages) and repairs of cars..... $9,880 \times 18.9 = 186,782$
Total yearly expenditure per mile..... $26,000 \times 17,000 = \$182,000$

Or, we may estimate only on the basis of the number of trains daily, which is about 44 each way. Then, by Table A,

$$\$4,550 \times 44 = \$200,200.$$

We may say then that, if our conclusions are correct, the present value of cutting out one mile of track on the Pennsylvania Railroad is something over \$180,000, assuming that it would involve no decrease in receipts from way business and also no decrease in train wages. If the latter were decreased in full proportion, this estimate should be increased by about 27 per cent. on this road (11x2.42), or, in round numbers, \$50,000, giving \$230,000 in all.

This saving has been valued by Mr. Herman Haupt (see "Considerations Affecting the Value of Distance Saved," *Van Nostrand's Engineering Magazine*, Vol. IV., p. 593; also *Railroad Gazette*, 1873, p. 267, and Vose's "Manual for Railroad Engineers," p. 46) at \$438,000, a difference of from \$200,000 to \$250,000 per mile in excess of the above estimate.

This difference is due to three causes: First, the cost per train-mile on the Pennsylvania Railroad was then (1869) \$1.30 per train-mile, instead of about \$1.00 as at present. This alone accounts for a difference of 30 per cent. Secondly, Mr. Haupt's estimate was (although not so stated) for the value of one mile saved at a particular point on the line, viz., west of Altoona, where distance is undoubtedly more valuable than for the average of the whole road. Thirdly, and mainly, Mr. Haupt's whole estimate is based upon the fallacy that all expenses which increase with tonnage transported increase also with the distance transported; and accordingly he has included several large items such as teaming, station labor, etc., which have no connection whatever with the exact length of the

↑ "If a railroad costs \$40,000 per mile, and the cost of maintenance and operation is \$10,000 per mile, we might spend \$206,666" (more than on the other line) "to shorten the line a mile." (*Manual for Railroad Engineers*, p. 46.)

2 This latter estimate should properly agree much more closely with the others, but the writer did not have the requisite information to separate main line expenses and train mileage from that on the branches. On the main line only the cost per train mile is probably somewhat less than \$1.00.

track, and in addition thereto has also included the full cost of fuel, repairs and other transportation expenses proper, of which only a portion can fairly be so included. This increases the estimate out of all due proportion, even if no other causes co-operated to do so.

If, instead of the Pennsylvania, we had selected any of the other 12 roads given in Table L, we should have obtained an equal general uniformity from the different formulae of Table A; but to avoid any appearance of unfairness, let us take, as an anti-illustration, the Syracuse, Binghamton & New York Railroad, on which the percentage of the various expenses has been widely different from those we have assumed. The average of the last four years has been as follows, viz.:

For maintenance of way..... 47.3 per cent \$2,700 per mile.
" engines and cars..... 16.1 " 920 "
" fuel, oil, etc..... 11.3 " 640 "
" train hands..... 5.7 " 330 "
" taxes and general expenses..... 19.6 " 1,130 "

Total expenses..... 100. " \$5,600 "
Average number of trains daily..... 8

We obtain from these figures the following valuations of one mile saved at 7 per cent. for capital; the first being the most exact:

By column (1), Table A..... $\$4,470 \times 86 = \$38,442$
By column (2), Table A..... $1,560 \times 19.4 = 30,264$
By column (3), Table A..... $2,300 \times 26.1 = 60,030$
By column (4), Table A..... $1,725 \times 16.2 = 27,945$
For \$1,000 of annual expenditure per mile..... $5.6 \times \$6,000 = 33,600$
For daily train..... $\$5,900 \times 8 = 31,200$

Here is a sufficiently wide divergence indeed; yet even in this case, had the road been originally located on the basis of an estimated business of 8 trains daily as in the last line above, or on the basis of \$5,500 to \$6,000 per mile of annual expenditure, it would have been a sufficiently good guide for location, as the wide variation in the above estimates is probably due in a great degree to errors in the apportionment of expenses or to temporary causes. We may repeat again that if the face of returns be accepted without scrutiny and if, moreover, an average be not taken extending over a considerable period, no close correspondence can be reasonably expected with the average percentages we have adopted.

[TO BE CONTINUED.]

Four-Wheeled Coal Car.

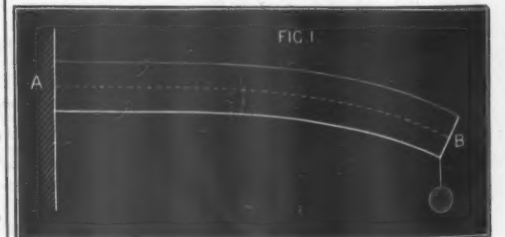
We give this week an engraving of the new pattern of coal car which has been designed for the New York Central & Hudson River Railroad Company. The engravings show its construction so clearly that little needs to be said about it, excepting that cars of this pattern weigh 9,500 lbs. and carry 16,000 lbs. of coal.

On the Subject of Deflection.

TO THE EDITOR OF THE RAILROAD GAZETTE:

Those who take an interest in the history of the literature of modern deflection may have their curiosity gratified by the catalogue of some scientific book publisher; or, if they wish to go into the foreign department of the subject, they may find some recent publications more valuable in this respect than in others; that is to say, in a Centennial manner, the annex is more interesting than the main building; but leaving all this to future engineering D'Israeli, I beg a little space for a few words on the deflection of girders; and will, for the present, confine my remarks to cantilevers or semi-girders, fixed at one end and loaded at the other, as being the simplest case.

The usual method of determining the deflection of such a girder is, using my own language, about as follows:



Let Fig. 1 represent a girder, fixed at one end and loaded at the other. The strain caused by the load will lengthen the upper and shorten the lower part of the girder; consequently between the two there will be a longitudinal line, called the neutral axis, whose length remains constant, or rather whose length after deflection equals the original length of the girder.

Now let us assume, first, that this neutral axis is midway between the upper and lower chords (their sections being equal) of the girder, which it is not; next, that all the strain above this axis is horizontal tension and all below horizontal compression, which it is not; and again, that in an vertical section the strain above this neutral plane (plane is better) is equal to that below, which again it is not.

Let E represent the modulus (or model) of elasticity, so-called because it is fixed by the books and not to be altered by experiment, and means the weight that will elongate or shorten a bar, of one square inch of transverse section, an amount equal to its length—that is, supposing the law of elasticity to hold good under "the press." This quantity was once supposed to depend on experiment, but modern professorial engineering scorns this. I should not say modern, as its standing is somewhat a question of doubt and of the future—something Wagnerian.

Let our girder be a truss, so that the horizontal strains may be confined to the chords, which are to be of uniform section, and let Fig. 2 represent a plan of this truss, $BOEH$ its original dimensions, and $ADFG$ its shape from the effects of the strains.

It is evident that if a certain tension will extend BC to AD , the same amount of compression will reduce the length of EH to FG , so that $CD=GH$ or $AB=EF$.

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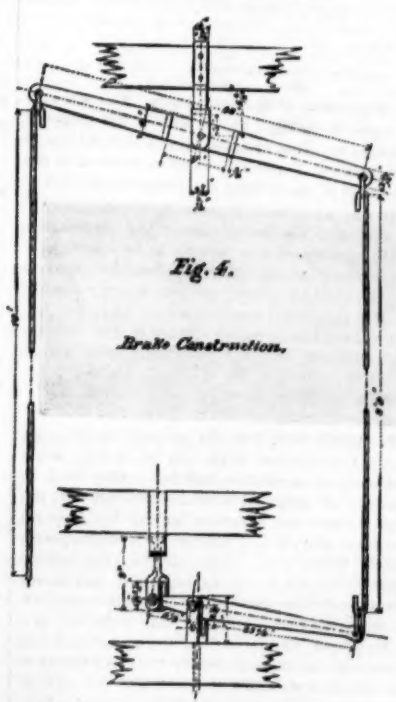
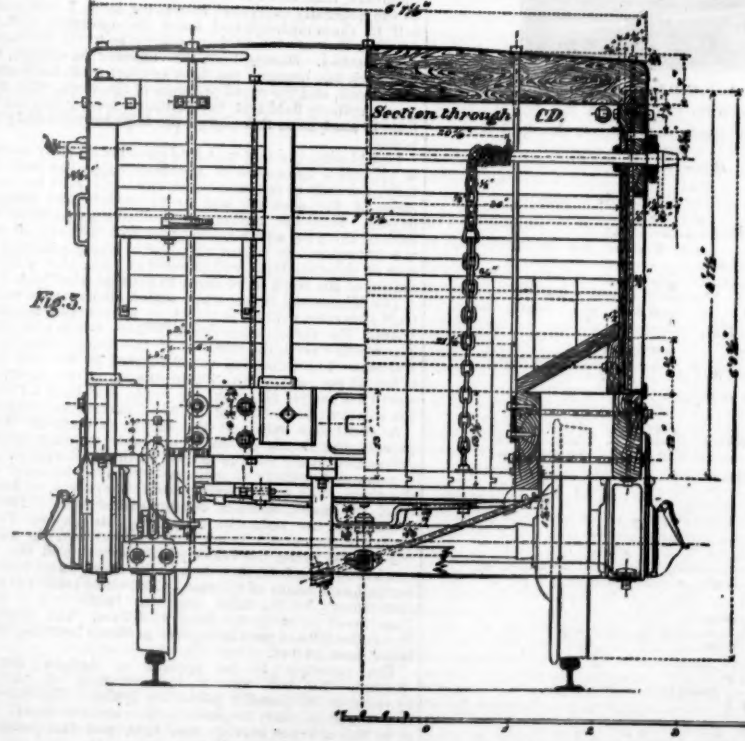
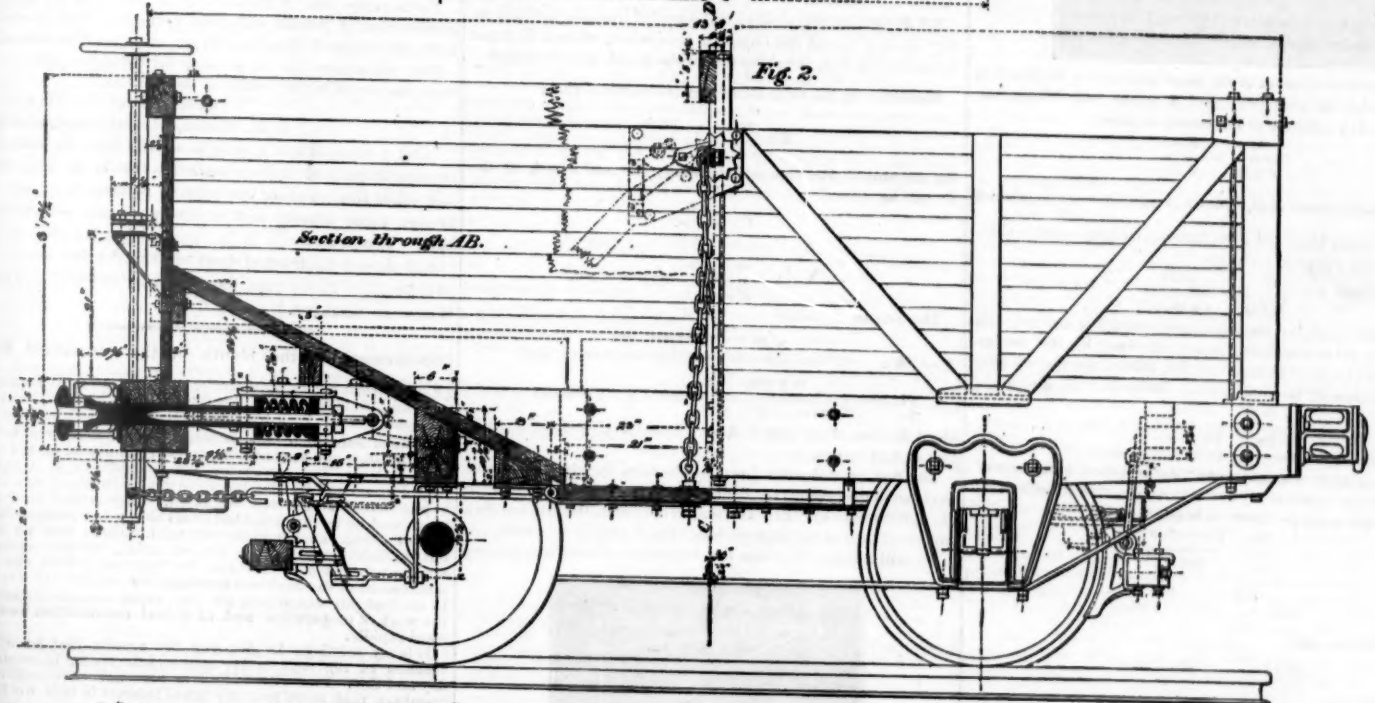
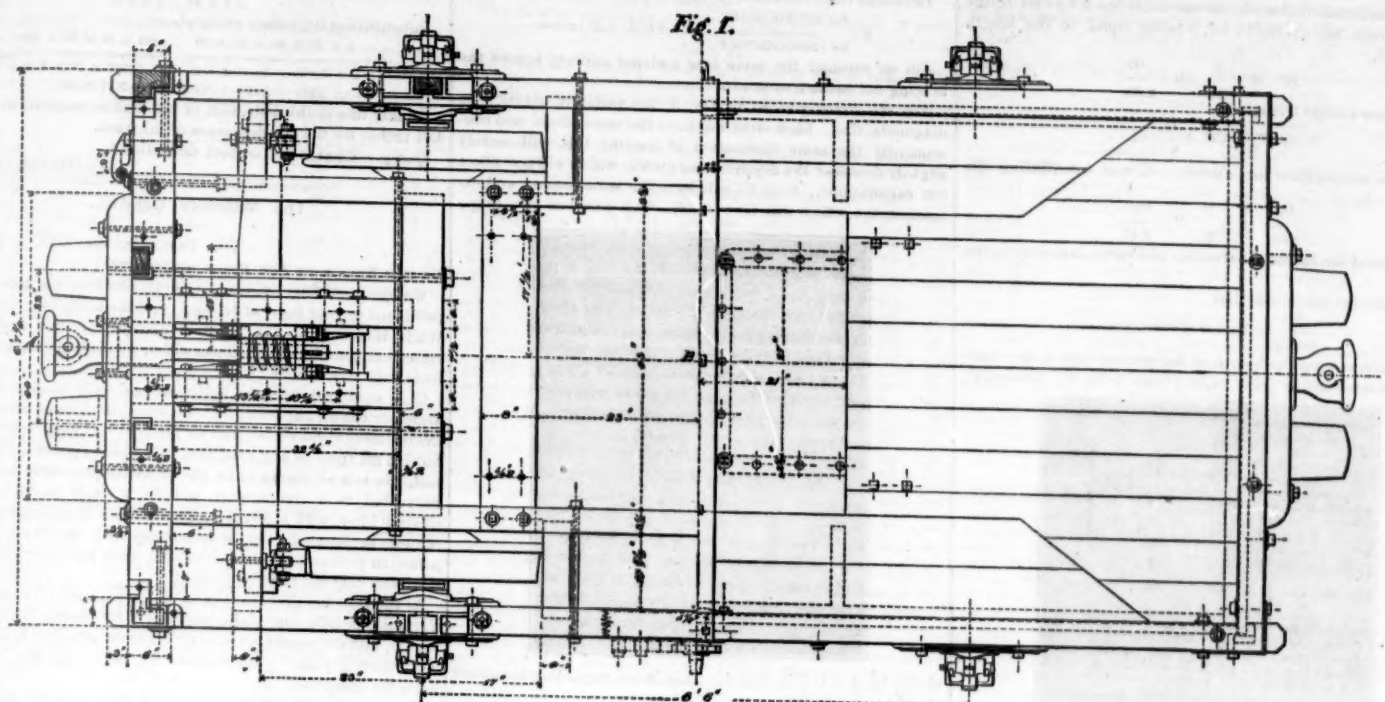
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FOUR-WHEELED COAL CAR.

Built by the New York Central & Hudson River Railroad Company, Leander Garey, Superintendent of Cars.

tend IC to double its length, we can easily know how far H , the actual strain, will extend it, for, p being equal to the length of a panel,

$$Ea : H :: \frac{p}{2} : \frac{Hp}{2Ea}$$

And from similar triangles,

$$CD : \frac{1}{2} CH :: \frac{p}{2} : R,$$

Let CH , the depth of the girder, be d , and substituting the value of CD ,

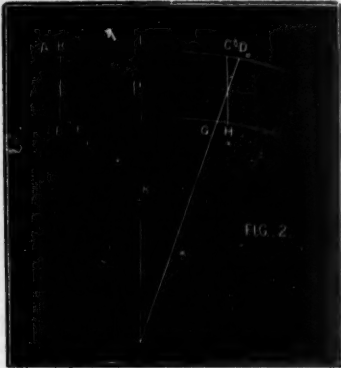
$$\frac{Hp}{2Ea} : \frac{d}{2} :: \frac{p}{2} : R = \frac{Ead}{2H}$$

R is called the radius of curvature and varies inversely as the strain.

The calculus informs us that,

$$\frac{ds^2}{dy dy} = \text{Radius of curvature.}$$

Here s represents the length of the neutral axis, x the horizontal distance of any point in that axis from the abutment,



and y the vertical distance of the same point below the junction of the axis with the abutment, and d means the differential. Then to get the equation of the curve, we have,

$$\frac{ds^2}{dy dy} = \frac{Ead}{2H}$$

Substitute the value of H , which is evidently $\frac{w(t-x)}{d}$, t being the length of the truss and x the distance from the wall or abutment, and this equation becomes,

$$\frac{ds^2}{dy dy} = \frac{Ead^2}{2w(t-x)}$$

This is very good, but until it is integrated it is useless, and this, Shades of Culmbacher! cannot be done by the accomplished artist in these things; but, Mr. Editor, we cannot stop the performance for impossibilities. Make $dx = dx$, and lo,

$$\frac{ds^2}{dy} = \frac{Ead^2}{2w(t-x)}$$

is something docile.

To appropriately commence our "mathematical gymnastics," as friend Bolter expressively terms these sportive exercises, we will stand this equation upon its head, thus:

$$\frac{dy}{dx} = \frac{2wt - 2wx}{Ead^2}$$

Then

$$Ead^2 \frac{dy}{dx} = 2wt - 2wx$$

Now integrate, and

$$Ead^2 \frac{dy}{dx} = 2wt - 2wx$$

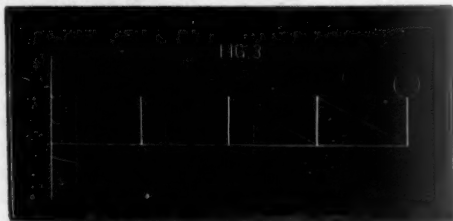
Once more, and

$$Ead^2 y = wtx - \frac{wx^2}{2}$$

Then

$$y = \frac{wtx}{Ead^2} - \frac{wx^2}{2Ead^2}$$

is the equation of the curve of the neutral axis. This was called the elastic curve by Galileo, who I believe first proposed it, probably because we insist upon its being a straight line to prove that it is a curve. Bernoulli, name so redolent of the light and joyous tasks of school days, also interested himself or



themselves in it. By the way, from the pleasant recollections of their clearness, I cannot but think how he or they would have advocated continuous girders, had he or they lived in these luminous days, or delighted their dry old souls with the solution of such momentous questions as the too frequent meetings of the hands of a clock (I will not quote Shakespeare) by graphic statics. Think of it. I hope, now that the question is solved and civilization advanced, our inquisitive and uneasy algebra makers will omit this particular "?" and give us a rest.

To return to the elastic curve equation: Our books tell us it is not exactly the proper thing, but it is "the style," and it is oh, so near. It would never do for vulgar facts and theory to agree, and this furnishes us with a simple test of the correctness of his work not generally explained to the student. It is, that if his calculation comes within thirty per cent. of the actual deflection, there is something wrong with his figures.

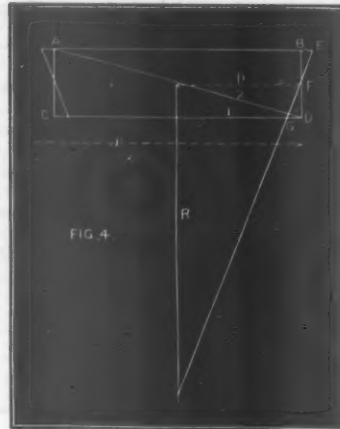
For the end deflection of the truss, $x=t$, and we have

$$y = \frac{2wt^2}{3Ead^2}$$

Let $w=10$ tons, $t=80$ feet, $E=12,000$ tons, $a=20$, $d=8$ feet, and $2 \times 10 \times 80 \times 80 \times 80 = 0.222$ feet = 2.67 inches.

Let us consider the same case and not entirely ignore the bracing nor assume so much.

Let the bracing be as in Fig. 3; the verticals, struts; the diagonals, ties. Each strut will have the same strain and consequently the same diminution of length; this will merely slightly decrease the depth of the girder, which will not affect our calculations. Each tie will have the same tension and extension, the effect will be to make each panel of the shape



shown by $ABCD$ in Fig. 4. This is not regarding the chord strains and changes.

AED (fig. 5) is practically a right-angled triangle, in which we have p , or $A E$, and can obtain $A D$ as below, whence ED and consequently EB , the deflection of one panel, may be found.

The strain in the tie is $\frac{wt}{d}$, t being its length. Then

$$Ea : \frac{wt}{d} :: t : \frac{wt^2}{Ead}$$

the amount of the elongation; hence the new length of the tie will be

$$t + \frac{wt^2}{Ead}$$

The length of a tie

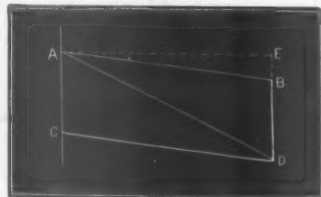
$$t = \sqrt{p^2 + d^2} = 12.8002 \text{ feet,}$$

$a = 3.6$, $p = 10$ feet, the other quantities as before, and,

$\sqrt{12.8002 + \frac{10 \times 164}{12000 \times 3.6 \times 8}} - 100 - 8 = 0.0088$ feet = $B C$, the deflection of one panel. And of 8 panels the deflection is 0.07 foot or 0.84 inches.

The line of deflection I propose to term the elastic tangent, because in discussions on deflections it is put out of sight with the quiet remark, "that, as a matter of course, the tangent does not vary;" and as my tangent does vary, I term it as above.

We will attempt to obtain the deflection without recognizing



the neutral axis. Let $ABCD$ be a panel of the semi-truss. Then x , being measured from the wall on the left to a lower chord panel point D , the strain in the upper chord, AB , is,

$$H = \frac{w(t-x)}{d}$$

and the strain in the lower chord opposite to this,

$$H = \frac{w(t-x+p)}{d}$$

The elongation of AB is,

$$Ea : \frac{w(t-x)}{d} :: p : \frac{pw(t-x)}{Ead} = 2BE.$$

The contraction of CD is,

$$Ea : \frac{w(t-x+p)}{d} :: p : \frac{pw(t-x+p)}{Ead} = 2GD.$$

Or,

$$\frac{pw(2(t-x)+p)}{2Ead} : d :: \frac{pw(t-x)}{2Ead} : \frac{d(t-x)}{2(t-x)+p}$$

From similar triangles,

$$BE : BF :: \frac{p}{2} : R,$$

or,

$$\frac{pw(t-x)}{2Ead} : \frac{d(t-x)}{2(t-x)+p} :: \frac{p}{2} : \frac{Ead^2}{2w(2(t-x)+p)} = R.$$

as before,

$$Ead^2 \frac{dy}{dx} = 2w(t-x) + wp.$$

Integrate and

$$Ead^2 \frac{dy}{dx} = 2wtx - wx^2 + c$$

Again,

$$Ead^2 y = wtx^2 - \frac{wx^3}{3} + \frac{wp x^2}{2}$$

at then end $x=t$,

$$Ead^2 y = \frac{2wt^2}{3} + \frac{wp t^2}{2}$$

$$y = \frac{2wt^2}{3Ead^2} + \frac{wp t^2}{2Ead^2}$$

Substituting the values given above:

$$\frac{2 \times 10 \times 80 \times 80 \times 80}{3 \times 12000 \times 20 \times 8 \times 8} + \frac{10 \times 10 \times 80 \times 80}{2 \times 12000 \times 20 \times 8 \times 8} = .2222 + .0417 = .2639 \text{ feet} = 3.17 \text{ inches.}$$

Adding this to the deflection of the elastic tangent, we have 4.01 inches for the end deflection of the truss.

Query.—What is the correct deflection?

P. WINKLE, C. E.

The Miltimore Car-Axle.

PHILADELPHIA, Sept. 4, 1876.

TO THE EDITOR OF THE RAILROAD GAZETTE:

We have carefully examined the extracts from our pamphlet, published in your issue of 1st inst., and the comments thereon. While insisting on the strictest accuracy of each and every statement contained in said pamphlet, we dissent emphatically from your conclusions.

Cars equipped with the Miltimore axle will show a lighter draft per ton on any straight, level track, than those fitted with the ordinary rigid wheel, and for proof of this assertion we will furnish for trial to any road that will give opportunity for the test, five sets of trucks to be placed under passenger cars, and submitted to a comparative test for a draft on curves and straight lines, with a corresponding number of rigid car wheels, the test to be conducted by any competent expert at our expense, in presence of yourselves and other interested railroad men who may see fit to be present.

At the time the first test quoted in our pamphlet was made in Vermont, in 1874, our claim was solely for saving friction on curves, and no separate test was made on straight lines, notwithstanding your "good reasons" for believing such to have been the case.

Furthermore, the Miltimore axle of 1876, with its improved construction of details, will show diminished draft on straight lines and curves of from 10 to 20 per cent. less than that of 1874.

This will account for the seeming discrepancies you claim to have discovered in the results of the two tests.

THE MILTIMORE CAR-AXLE CO.

R. H. MORRIS, General Superintendent.

[Our correspondent's reply is a little evasive; were there or were there not any experiments made in 1874 or at any other time to show the relative resistance of the Miltimore loose wheels and ordinary wheels on a straight line? If not, how can it be known that the axle of 1876 "will show a diminished draft on straight line and curves of from 10 to 20 per cent. less than that of 1874?"—EDITOR RAILROAD GAZETTE.]

Improvement of the Mouth of the Mississippi River.

[A paper read before the American Society of Civil Engineers, June 15, 1876, by E. L. Corbitt, C. E., Chief Assistant Engineer South Pass Jetty Works.]

In the discussion of this subject, it may be of interest to state that this day, one year ago, work was commenced on the South Pass jetties. The contractor, James Andrews, of Allegheny City, Pa., arrived the day before with a stern-wheel steambot, a pile driver and a few workmen. They landed among the reeds, and broke down the tall grass along the banks to find a place for their anchor in the soft mud. There was no house but the light-house within several miles, and with swarms of mosquitoes and sand-flies and the oppressive heat, the commencement of the work was anything but auspicious. On June 15 the first pile was driven for the wharf at Land's End, and the work of preparation and of actual construction went forward rapidly.

It is my privilege to give you the results that have been reached in the first twelve months intervening between that day and this. I am glad to find, by personal conversation with members, that there is a very great interest in this work, and as the generally expressed wish is for facts, I will confine myself to them entirely, and leave the question with you as to whether they are favorable or otherwise to the ultimate success of the jetties. Having been the engineer in charge, my peculiar work has brought me into contact with facts and actual conditions, and the rapid progress of the work, with the consequent arduous field and office duties, have given me but little time to analyze or theorize on the facts brought daily under my notice.

Considering the fact that this question of jetty construction, as applied to the mouth of the Mississippi has been discussed fully, not only in engineering circles, but also by the general press of the country, and in pamphlets and Congressional papers, until the nation, as a whole, is familiar with the various theories advanced to prove and disprove the success of the enterprise, it is not my place to weary you with a discussion of theories, but I will proceed at once, after a brief explanation of the work to be done, to present what facts I have.

The Mississippi River, when within about twelve miles of the Gulf separates into three rivers or passes, and thus forms the Delta. The three passes are A l'Outre, South and Southwest. The South Pass is the smallest of the three, though the central one. The volume of water carried to the Gulf through it is but 12 per cent. of the whole volume of the river. Southwest Pass carries about 58 per cent., and Pass A l'Outre, with the smaller passes flowing out of it, carries the remainder.

A shoal bar exists at the mouth of each of these three passes, the depth of water on each varying generally in proportion to the volume carried to the Gulf over it. This bar is composed entirely of sedimentary matter brought down by the river. The water issuing from the passes, no longer confined by banks, spreads out on either side. The velocity diminishes, the sediment drops, the bar forms. The central thread of the current being the strongest, and the water being the deepest there, the velocity is preserved and the sediment carried out much further than in the shoal water over the submerged new banks of the pass. The outer crest of the bar is thus thrown out 2½ miles from the land's end at the South Pass, and 5 miles at the Southwest Pass. The depth on the bar at the former pass is 7½ feet at mean low tide, and at the latter pass, 15 feet.

The principle to be applied to deepen the channel through the bar was a concentration of the volume by means of parallel jetties or dykes. Whether its application will be likely to produce the required depth, viz.: from 20 to 30 feet below average flood tide, you can judge from the facts to be presented.

It was doubted by some whether the material composing the bar, being freshly deposited, would have sufficient solidity to uphold works of the requisite weight and strength to resist the vicissitudes of storm, waves and river currents. The following

table will give a better idea of the character of the jetty foundation than any description.

TABLE I.
Showing Character of Foundation of Jetties from Record of Pile Driving.
Piles from 8 to 20 feet apart. Distances in tables are from Land's End, east side; piles 10 inches at small end and 14 inches at large end.

LOCATION OF PILES.	Weight of hammer.	Average fall of hammer.	Average of blows.	Average depth driven.
	Pounds.	Feet.	Number.	Feet.
East Jetty.				
From 4,300 to 5,500 ft.	3,000	18.5	44.0	18.7
" 7,300 to 12,100 "	3,000	18.6	98.0	17.4
" 9,100 to 9,300 "	3,000	18.6	45.0	28.2
West Jetty.—Whole length of same.	3,000	19.5	79.7	19.5

Analysis of number of blows for different depths on west jetty; approximate—
Number of blows first 5 feet driven, 4, or 15 inches per blow.
" " next 5 " " 30, or 3.5 " " "
" " 4 1/2 " " 30, or 2.7 " " "
" " last 4 " " 35.7, or 1.3 " " "

It will be seen from Table I., that at about 9,300 feet on the east jetty, the material is much harder than elsewhere, and the detailed record of the pile-driving on the west jetty shows the same material to exist there, at the same distance. The channel on the line of this hard material resisted much longer than that of any other locality the excavating power of the current.

The following table illustrates the progressive deepening towards the outer bar. The contours refer to the plane of average flood tide as established by Maj. C. B. Comstock, who is inspector of the work for the United States Government. The distances in all the tables are from a common zero point at Land's End at the commencement of the east jetty, and from a triangulation station named East Point, established by Mr. Marindan of the United States Coast Survey, whose charts, made from a survey terminating in May, 1875, are the basis on which our location was made, and which we still use for comparative purposes.

No record of the 22 and 24 feet contours was made prior to March 29, 1876.

TABLE II.
Record of distances in feet through the bar between the contour lines.

WHICH CONTOUR.	May 1875.	Dec. 1875.	Jan'y 1876.	Feb'y 1876.	Mar. 1876.	Apr. 1876.	May 1876.	July 1876.
13 Feet ..	4,305	2,635	750	0	0	0	0	0
15 "	5,925	4,400	4,175	2,175	450	50	0	0
16 "	7,000	5,092	4,480	3,960	2,575	1,800	750	175
20 "	9,635	6,215	5,425	4,400	3,255	2,955	2,200	75
22 "						5,370	9,995	1,350
24 "						7,000	5,975	3,120

These distances embrace all portions of the bar that rise above the contours between the 35 feet depth at Land's End and the deep water outside the bar. The progressive reduction in the size of the bar is generally in comparison with the progress of the jetties, especially at the earlier dates. The surveys from which this and tables following are compiled are made in the most thorough manner, and with no effort spared to render the surveys accurate and the result reliable.

The deepening has been affected by the operation of the river current and by the tides, although the latter in this portion of the Gulf are diurnal and feeble, having an oscillation of 22 inches only, between mean low water and mean high water, yet at the season of highest and lowest tides the scouring power of the current is considerably augmented.

Tables II., IV. show the progressive depths in the line of deepest water. It will be noticed by an examination of these tables, that there are irregularities in the progressive depths and widths, all of which explain themselves. It will be noticed that the attempts of the concentrated volume to excavate a channel were peculiar and at times spasmodic, that a

TABLE III.
Depths (comparative) in Line of Deepest Water, in Feet.

Distances from East Point.	May 1875.	Dec. 1875.	Jan'y 1876.	Feb'y 1876.	Mar. 1876.	Apr. 1876.	May 1876.	June 1876.	July 1876.
E. Pt.	31.8	37.0	37.0	38.0	38.7	38.0	37.5	37.1	37.1
1,000	31.0	28.3	28.0	28.0	28.0	28.0	28.5	28.7	29.0
2,000	21.8	22.8	23.0	23.0	23.2	23.0	23.9	24.0	25.0
3,000	18.8	22.5	22.0	21.8	21.2	22.5	21.4	21.9	21.6
4,000	18.0	22.0	22.0	22.0	22.0	21.8	21.4	21.9	21.1
5,000	18.0	22.3	22.4	22.5	22.4	22.8	22.9	23.5	23.6
6,000	18.0	22.3	22.9	23.5	23.9	23.3	21.5	23.3	30.3
7,000	17.7	23.0	21.4	28.5	25.4	27.1	28.0	28.2	30.3
8,000	16.0	19.8	21.4	23.3	24.9	25.1	27.0	25.5	26.8
9,000	14.3	18.8	22.2	22.4	25.4	28.4	30.6	29.1	27.3
10,000	14.0	16.2	18.1	17.3	23.2	24.3	28.1	30.1	26.8
11,000	13.0	15.6	20.1	24.5	25.4	26.0	24.4	26.0	26.0
12,000	11.8	13.5	14.6	24.5	22.5	21.8	24.7	27.4	24.9
13,000	11.0	13.0	14.1	18.0	18.0	22.4	26.9	28.3	26.4
14,000	11.0	13.0	14.5	18.0	18.2	28.0	32.4	30.3	28.9
15,000	10.9	13.3	13.1	15.0	20.4	23.2	25.8	27.6	29.9
16,000	10.5	11.8	13.0	15.0	18.0	23.2	26.9	26.8	27.6
17,000	10.8	10.8	11.6	13.0	17.4	20.3	47.3	45.0	38.8
18,000	10.0	11.0	12.6	14.0	16.0	22.3	33.9	34.0	42.8
19,000	9.5	9.3	12.0	16.6	16.7	19.8	32.7	33.0	30.8
20,000	9.3	9.8	12.0	14.6	15.0	19.2	24.5	26.2	28.3
21,000	9.3	11.3	12.0	15.0	15.9	18.2	22.7	21.5	28.3
22,000	9.2	16.8	17.0	18.0	15.0	17.0	18.0	21.0	22.4
23,000	11.8	18.0	18.0	18.5	19.0	18.0	14.5	18.3	22.8
24,000	20.8	40.8	44.2	18.2	20.8	23.0	30.2	30.5	20.0
25,000	31.0	40.0	35.0	30.0	47.0	43.3	25.0	20.0	22.8
26,000	35.0	.....	.....	.....	.....	.....	.....	.....	41.8

desperate attempt to deepen the channel would result in a channel too deep for the necessities of the case, and a widening taking place soon after, the depth would become less. It may be taken as a general fact that an unusual and extraordinary deepening would result in a widening and a subsequent shoaling, and that a narrowing out of the channel would indicate a deepening.

The peculiar condition of the work also tended to produce irregularities; for instance, when the dam connecting the upper end of the west jetty with the shore was built, there was a head of water produced against it, extending to the east jetty, but diminishing as it approached the latter. This condition produced quickly a deep channel below the line of the dam, and the channel above the dam had a tendency to shoal slightly, caused by the reduction of velocity which the head of the water had produced.

The deep channel immediately below the line of the dam caused a temporary shoaling at a point about 500 feet below the dam, as the velocity for the first 300 feet was too great to be maintained. A comparison of the bottom velocities above and below the dam, as ascertained immediately after its closure, will further illustrate the subject. The dam is located 4,800 feet from East Point, and nearly at right angles to the

jetty lines. Above 4,000 feet, the velocity was 2.3 feet per second; from 4,000 feet to 4,500 feet, 2.86 feet per second, and from 4,500 to 5,000 feet, 2.31 feet per second.

The varying conditions of the river and the amount of sedi-

TABLE IV.
Record of Width in feet, of Channel at a Depth of 20 Feet, on the Established Cross Sections and at different Dates.
A dash in the columns, denotes less than 20 feet depth at the date where it occurs.

Location of Cross Sections.	May 1875.	Dec. 1875.	Jan. 1876.	Feb. 1876.	Mar. 1876.	Apr. 1876.	May 1876.	June 1876.	July 1876.
E. Pt.	408	553	553	493	500	520	520	540	540
1,200	430	470	470	441	480	490	450	440	440
2,200	29	492	492	480	433	470	430	410	465
3,000	—	325	325	213	300	470	410	350	470
3,500	—	300	300	290	285	480	470	300	200
4,000	—	30	305	312	366	392	340	380	370
4,500	—	110	260	165	300	345	343	300	290
5,000	—	—	305	167	165	205	202	140	170
5,500	—	—	165	207	184	205	205	205	225
6,000	—	—	82	75	122	212	308	340	450
6,512	—	—	—	—	65	190	280	338	315
7,125	—	—	10	215	210	326	390	320	370
7,584	—	—	—	145	155	260	350	340	360
8,000	—	—	—	17	118	192	308	350	325
8,500	—	—	—	—	—	90	338	340	395
9,000	—	—	—	—	—	64	295	380	380
9,300	—	—	—	—	—	—	105	270	410
9,600	—	—	—	—	25	38	203	300	360
10,500	—	—	—	—	—	—	300	290	385
11,000	—	—	—	—	—	—	208	345	410
11,500	—	—	—	—	—	—	100	120	335
12,100	400	1,000	640	320	868	—	217	200	385

ment carried in suspension, the difference in the material composing the bar at various places, the state of the tides, the direction and force of the winds, the storms and resulting seas that rolled in against the current, the conditions of the works at Grand Bayou and at the head of the pass, the state of the jetties especially—all conspired to render the work of channel excavation irregular, but taking the general progress into account the advance in depth and width has been constant and steady, and the effect of the jetty construction has shown that the volume of water issuing from the pass will eventually recover the section it has normally above.

A dam has been thrown across Grand Bayou, and above 90 per cent. of its volume turned into the pass. It is reasonable to expect that the section between Grand Bayou and the sea end of the jetties will enlarge until it is as large as that above Grand Bayou or to an ultimate section of 25,000 square feet, it now being 15,000 square feet. (Reference is made to Table V., following.) It is also reasonable to expect that the section between the jetties will finally be larger than the section above Grand Bayou, as a larger volume will necessarily flow between the jetties during the ebb of the tides than flows through the pass above Grand Bayou, as the range of the tide is greater and the slope steeper near the gulf than it is 8 miles above.

TABLE V.
Comparative Areas of Sections of South Pass.

LOCATION OF SECTION.	Plane of Reference.	Area in Square Feet.	Date of Survey.
One mile below head of pass.....	Mean high water.	24 395.0	U. S. Coast Survey, May, 1875.
	of U. S. Coast Survey.....	25 097.3	Jetty Engineers, Aug. 2, 1876.
3 600 feet above Bayou Grande.....	Mean high water.	23 243.0	U. S. Coast Survey, May, 1875.
	of U. S. Coast Survey.....	26 037.0	Jetty Engineers, May 17, 1876.
South Pass light-house.	Average flood tide.	16 711.0	U. S. Coast Survey, May, 1875.
	of U. S. Engineer's....	17 006.0	Jetty Engineers, July 30, 1876.
5 500 beyond Land's End and between the jetties; present depth, maximum 27 feet.....	Average flood tide.	14 804.0	Jetty Engineers, July 30, 1876.
	of U. S. Engineer's....	.....	.....

But the facts relative to final sections and volumes and velocities during the formative state of the channel through the Bar and the reformatory state of the pass between Grand Bayou and the mouth cannot be obtained at present. All the old natural conditions of the pass, from its head to the gulf, and far beyond the sea ends of the jetties, have been disturbed by the construction of the auxiliary works, especially those at the head of the pass which are intended to deepen the shoal at that point. When the whole work is finished and the normal condition of the pass restored by time, there will be very many interesting and valuable facts which no doubt will be given you.

A very important question, and one that cannot be definitely determined by facts until the completion of the jetties, is that of an accelerated bar advance due to the construction of the jetties. All that we can state now, bearing on this question is, that although there has been a pushing outward of the upper part of the outer slope of the bar, due to three or more temporary causes; first, the impossibility of constructing the whole line of jetties instantaneously; second, the large amount of material excavated and carried out to sea; third, the closing of Grand Bayou and a new load of sediment given the water in addition to its already heavy burden; and fourth, the non-completion of sea ends of the jetties to a point designated by the Advisory Board of Engineers, who assisted Capt. Eads in determining the plans for construction; yet careful surveys and calculations show a deepening instead of a shoaling immediately in front of the sea ends of the jetties. The water prism extending seaward from the old crest of the bar, and covering an area of 52 acres, has increased from 2,000,000 cubic yards to 2,200,000 cubic yards, or, in other words, the average deepening over the whole area investigated is 2 1/2 feet. The survey on which the calculations were based was made May 29 last. A survey by radial lines of sounding, extending five miles out from the jetties, made in May by Mr. H. L. Marindan, of the United States Coast Survey, shows by comparison with the chart of the survey of May, 1875, made by him, that there has been an average deepening of the whole area surveyed.

The volume of the bar removed during the first year of the work, without reference to the amount moved in the channel as required by law, or, in other words, the total excavation, exceeds 3,000,000 cubic yards. The following table shows the volume of the bar moved in reference to a channel 20 feet deep and 200 feet wide at that depth.

The results are obtained by placing on the cross sections, drawn on profile paper, a normal section as we find it in the pass above the jetties. This section has a centre depth of 2 feet below the 20 feet line and side slopes of 1 foot vertical to 20 horizontal. This normal section is made on tracing paper,

then placed over the cross sections, and the area is thus obtained for the calculation, as to the volume to be moved to make a channel of the normal section as described.

TABLE VI.
Volume in Cubic Yards of the Bar Removed in Reference to a 20 Feet Channel.

Date of Survey.	Volume to be Moved.	Vol. Moved.
May, 1875.....	1,037,635	.....
Dec. 25, ".....	622,680	414,955
Jan'y 27, 1876.....	524,909	97,771
" 31, ".....	506,643	18,266
Feb'y 17, ".....	499,715	8,228
March 4, ".....	305,547	195,168
" 25, ".....	256,685	45,892
April 25, ".....	163,619	93,036
May 29, ".....	22,827	140,992
June 30, ".....	13,997	8,650
July 31, ".....	4,985	8,992

A part of the material has fallen over the submerged jetties during their construction, or has been driven in by the waves from beyond the sea end of the jetties and lodged on their sea slopes. 1,000,000 cubic yards, at least, have piled themselves up against the sea side of the jetties, an enduring and solid bulwark against the storms. The remainder has gone far to the westward, no doubt carried there by the prevailing westward coastwise current.

The so-called "litoral current" is a current generally existing and has a westward course. Whether it is caused principally by the prevailing northeast winds or by a more constant and stronger influence, is somewhat doubtful. We have strong evidence from an examination of the general formation of the coast of Louisiana and Texas, from the eastward bend of the lower river towards that direction, by the excess of accumulation of sediment and subsequent shore formation westward, from the general opinion of longshoremen and pilots and from our own observations, that there is a distinct and constant and deep-moving westward litoral or coastwise current, strong enough to remove far from the mouth of our new channel the sediment carried out by the river, and which will postpone for a century or two the re-formation of the bar.

In regard to action of Gulf storms upon the work, I will state that during a severe storm on March 5, which continued several days, a few mattresses on the sea end of the west jetty were destroyed, but the work had not been consolidated nor sufficiently covered with stone. The plan of final construction provides for jetty heads of enormous base, easy slopes and a covering of heavy stone. From the experience had, we have no doubt of the ultimate stability of all parts of the work, both in reference to Gulf storms and the river currents.

The facts given and the tables and sections exhibited are the result of careful surveys and faithful office work. Extended and often repeated surveys have been needed to inform us of the progress of the works and the results they are constantly accomplishing, and often so rapidly that our surveys could not keep pace with them.

The paper under discussion gives us the pivotal fact, which guarantees the success of the jetties, that the deep water of the pass follows close behind the bar in its seaward march. Examine the tables presented and you will see that this fact is clearly and forcibly illustrated. It may be said, truthfully, that twelve months of work and its accompanying results have proved every theory advanced and every prophecy made in that paper. It and this account—one presented at the commencement, the other, one year after the beginning of the work—are substantially the same, the latter being simply illustrative of the other.

NOTE.—There were 21 feet of water through South Pass bar August 16, 1876.

THE SCRAP HEAP.

Stealing in Spite of Checks.

The Pennsylvania Railroad Company, as part of its leased New Jersey lines, runs two ferries between New York and Jersey City, and over these ferries there passes a very large local travel independent of that to and from the railroad. In order to secure the honest collection of the ferry charge, three cents, from these outside passengers, an elaborate system was adopted some time ago, by which two gates were established at each ferry, the passenger paying his three cents at the first one and receiving a ticket, which he had to deliver to the collector at the second gate before he could pass into the ferry-house. The tickets received in this way were expected to show what amount of money should be returned. Now, however, several of the ferry collectors are on trial for defrauding the company. It appears from the testimony of one of them, who confessed his guilt, that there was an understanding between the money collectors and the ticket collectors. The latter, instead of putting the tickets into the box provided for them, would slip some occasionally into their pockets and, after going off duty, would privately hand them over to the money collectors, who would resell them and divide the proceeds. The amount thus taken cannot be ascertained, but it is said that after the discovery and arrest of the dishonest collectors the ferry receipts increased over \$100 per day. This seems almost incredible, but the number of ferry passengers is so large that it may easily be possible.

A Railroad Company as a Farmer.

The Philadelphia & Reading Company believes in making use of the waste land, as is shown by the following from the West Chester (Pa.) News: "The Reading Railroad Company last fall sowed with wheat sixty of the eighty acres of their tract of land, just below Marcus Hook, and have just been gathering in their crop. The grain has been cut and threshed in the field, getting out from 250 to 300 bushels per day at a cost of ten cents per bushel. It is expected that 1,000 bushels will be realized, though being over ripe at the time about 50 bushels of it were lost. The farm managers for the company are Huddell & Mahoney, who planted it with seed wheat at a cost of \$100. The land, which is just a little south of Trainer's station, was formerly the property of Nathan Pennell, and was considered quite productive. It will now be thrown open for town lots, thus making complete the connection link between Chester and Marcus Hook."

Sleeping Cars in Europe.

Since the beginning of July the Mann sleeping cars have been running regularly between Paris and Frankfurt-on-Main, leaving Paris on the express train at 7:30 p. m. and arriving at Frankfurt at 20 minutes after noon the following day, and leaving Frankfurt at 4:45 p. m. and reaching Paris at 9:40 a. m. These cars are the invention of an American, but are similar in construction to European cars, being 4-wheeled, and divided into compartments. They are managed much like American sleeping cars. The passenger is required to have a first-class ticket, and can get his sleeping-car ticket of the sleeping-car conductor. The price of a berth is 16 francs (about \$3.10 gold) for the journey. These cars were introduced into Europe some three or four years ago by Col. W. D. Mann, an American, who has organized there a "Mann Sleeping-Car Company," which is apparently much like our Pullman Company, though as yet it is not nearly so well introduced.



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Editorial Announcements.

Passes.—All persons connected with this paper are forbidden to ask for passes under any circumstances, and we will be thankful to have any act of the kind reported to this office.

Addresses.—Business letters should be addressed and drafts made payable to THE RAILROAD GAZETTE. Communications for the attention of the Editors should be addressed EDITOR RAILROAD GAZETTE.

Advertisements.—We wish it distinctly understood that we will entertain no proposition to publish anything in this journal for pay, EXCEPT IN THE ADVERTISING COLUMNS. We give in our editorial columns our own opinions, and those only, and in our news columns present only such matter as we consider interesting and important to our readers. Those who wish to recommend their inventions, machinery, supplies, financial schemes, etc., to our readers can do so fully in our advertising columns, but it is useless to ask us to recommend them editorially, either for money or in consideration of advertising patronage.

Contributions.—Subscribers and others will materially assist us in making our news accurate and complete if they will send us early information of events which take place under their observation, such as changes in railroad officers, organizations and changes of companies, the letting, progress and completion of contracts for new works or important improvements of old ones, experiments in the construction of roads and machinery and in their management, particulars as to the business of railroads, and suggestions as to its improvement. Discussions of subjects pertaining to ALL DEPARTMENTS of railroad business by men practically acquainted with them are especially desired. Officers will oblige us by forwarding early copies of notices of meetings, elections, appointments, and especially annual reports, some notice of all of which will be published.

DISCRIMINATIONS IN RATES.

Pittsburgh is perhaps one of the greatest sufferers from the great fluctuations in through rates. Situated about half way between New York and Chicago, with all its western outlets substantially in the hands of a single company, it has to pay local rates on most of its traffic; and this traffic is an enormous one, the productions of the city being chiefly iron, the heaviest and cheapest of manufactures. At a cent a ton a mile, the transportation of a ton of iron rails from Pittsburgh to Chicago adds as much as 12 per cent. to the cost at the Pittsburgh mill, which must compete not only with the Chicago mills, but with those further east. When in the course of a railroad war like that now prevailing the rate from Philadelphia to Chicago is reduced to 15 cents per hundred, the Pittsburgh manufacturer may see Philadelphia rails carried past his doors 350 miles further to Chicago at \$1.70 a ton less than the charge on his rails, and for this reason, perhaps, he is excluded from markets which otherwise he could supply. Probably the example cited is not quite fortunate, as at present it is the Western rather than the Eastern mills which are the most formidable competitors of Pittsburgh for the supply of the Northwest in the article of rails. But there are many other heavy manufactures in which Pittsburgh's competitors are chiefly further east; and in these a difference in freights such as often occurs may be sufficient to exclude one or the other from the Western markets.

These differences, or greater ones, exist in the case of many other cities; but few, if any, are so much affected by them as Pittsburgh, and, indeed, they suffer so little that they do not often complain of the difference. This is due to the fact that freight rates at the present day, even local rates on the trunk lines, are so low as to form an inconsiderable addition to the cost of most kinds of merchandise. With iron this is different. As we have seen, a cent per ton per mile from Pittsburgh to Chicago is about 12 per cent. of the present Pittsburgh price of iron rails. The same rate from New York to Chicago would be nearly 50 per cent. of the New York price of some grades of pig iron. Evidently, with merchandise whose weight is so great in proportion to its value, the cost of transportation is much more important than with ordinary goods. As iron is worth but a dollar to two dollars and a half a hundred, a few cents per hundred more or less in the freight charges make a substantial difference.

It is not surprising, then, that Pittsburgh, though usual-

ly favored with rates which, in proportion to the cost of transportation, are entirely reasonable, still complains of its rates more than any other city, perhaps. Its complaint, as that of several other places has been of late years, is really not that its rates are unreasonably high, but that the rates of competing cities are often unreasonably low, causing a discrimination which bears hard upon its most important industries.

This is a legitimate subject of complaint, and none the less so because it is hardly in the power of the Pittsburgh railroad companies, of themselves, to prevent the evils complained of. These are due partly to the nature of things, and partly to the undue competition for through traffic, which makes all through rates frequently and some through rates almost always unreasonably low, and which cannot be prevented by the action of any one road or group of roads, but only by the combined action of all the competing roads.

It is probably due to this condition of things at Pittsburgh, which is but an aggravated form of the condition of things at hundreds of other towns, that the members of Congress from Western Pennsylvania have endeavored to procure legislation to prevent the discriminations complained of. Last spring Mr. Hopkins, of Pittsburgh, introduced into the House a bill "to regulate commerce and to prohibit unjust discriminations by common carriers," which is still, we believe, in the hands of the Committee on Commerce. Its provisions, intended doubtless simply to prevent evils which can hardly be denied, like those of many similar laws, are opposed to some of the principles which govern the economical conduct of transportation business, as we shall try to show.

The proposed law requires that the tariff of a railroad for inter-State freight shall, substantially, consist of two parts, which shall be invariable in all cases and under all circumstances. These shall be the terminal charge, including handling, storage, etc.; and the transportation charge per 100 lbs. per mile. These charges must not be changed oftener than once in three months, and then ten days' public notice of the change must be made. The published schedule of rates must show whether any drawback is allowed, how great it is, and on what terms it is given.

The establishment of an absolutely uniform rate per mile is simply a repetition of the proposition so often brought before the New York legislature for a *pro rata* freight law. It ought not to be necessary to repeat the arguments against it. The railroads on which such a rate would be applicable must be very few, if indeed a single one exists. The French system of tariffs was based on this principle, but it has been found necessary to make so many exceptions—"international tariffs," "export tariffs," "differential tariffs" and the like—that only a fraction of the freight is carried at the regular tariffs. The result has been the same wherever the uniform rate per mile has been tried: it is absolutely inapplicable without injury to both carriers and community. The equality which shippers have a right to claim is equality under like circumstances. If A is given a rate of 15 cents a hundred on a shipment of ten car-loads from Pittsburgh to Baltimore, B has a right to complain if he is charged 16 cents on a similar shipment. But if the rate from Pittsburgh to Baltimore is higher than that from Erie to Baltimore, the discrimination in favor of the more distant place may be perfectly justifiable. Perhaps with a higher rate the traffic would all go by lake and canal to New York or by lake and river to Montreal; and perhaps the Erie-Baltimore rate per mile, if extended to all shipments from points between the two places, would leave the railroads too little net profits to pay interest on the investment. Such instances occur on almost every railroad and are unavoidable. Many, doubtless, might be avoided, if there was a perfect combination among the railroads—those in which the extreme reductions are caused solely by railroad competition; but even then there would remain a great many cases in which discriminations of this kind would have to be made. Indeed, the bill itself recognizes this fact in an indirect way; for it requires that the rates per mile shall be made for "the various classes of freight."

Now the chief basis of the whole system of classification is not the varying cost of carrying different kinds of goods, but the varying price which these goods can afford to pay. There is some difference in the cost of handling; and the responsibility of the carrier of course varies with the value and destructibility of the freight carried; but this is in the nature of an insurance charge, susceptible of accurate computation: and it will be found that the classification of goods easily handled and not susceptible of injury by no means corresponds with the value of the goods. Tea, for instance, is a valuable freight, bulky, and when it could be obtained in the interior only by transportation from the Atlantic ports, it bore a high rate. But tea is now carried from San Francisco to New York at one of the lowest rates afforded on the Pacific railroads, simply because at higher rates it would all go by sea. Canned milk, when there were no factories for condensing it west of New York, paid first-class rates readily, and these did not increase the cost in St. Louis more than a cent or two a pound; but as factories were established in the West and

in various parts of the East, it became necessary to reduce the rates or go without the traffic in this article. If the reader will look over a table of classification of freights, he will find that many kinds of goods of value, the risks on which are comparatively costly to the carrier, are in the lower classes. Some of these are more costly to handle, too, than cheaper goods which are placed in higher classes. The classification is, to a great extent, a discrimination, goods being placed in a low class when they will not move if placed in a higher one; and the carrier being eager to make a little profit on a shipment if he cannot get a larger one.

After all the discussion there has been on this subject it ought to be impossible for a bill embracing such a clause to pass in Congress. But the experience of the past ten years has shown that there is scarcely any folly in transportation legislation which is not possible. In the investigations made by committees of Congress and other officials, the railroad companies will do well to present at some length the facts which make it impossible to maintain equal rates for equal distances. If only a thorough investigation were made by a capable committee or board, it would hardly be necessary to do this work more than once.

The New York & Long Island Bridge.

Since the announcement of the board of directors that the time for receiving plans for this bridge has been extended, a good deal of interest has been manifested in this project. Besides being a work of great magnitude, it presents a number of very interesting engineering problems, the solution of which the board of directors have opened for public competition.

The bridge is intended to cross the East River, which separates Manhattan Island or New York City from Long Island, at Astoria. At the point at which it is intended to cross the river, the latter is divided into two channels by Blackwell's Island, near the centre. The approach on the New York side will be 4,580 feet long. The west channel must be crossed by a single span 734 feet long in the clear, and Blackwell's Island by an iron structure about 700 feet long, and the eastern channel of the East River by a single span 618 feet long. The lowest part of each of the long spans must be 135 feet in the clear, at the middle of the river, above mean high tide. The approach on the Long Island side will be 3,900 feet long. There is, fortunately, solid rock which is available for foundations and anchorage wherever these will be needed. The profile, fig. 1, will show the general character of the locality perhaps better than any description would, and the following from the "Specifications for Designs" describes the general character of the structure:

"The bridge shall be designed to accommodate:
"1. A single-track railway extending over its entire length, and occupying a width of 14 feet. To be so arranged that a second track can be added hereafter without materially changing the general arrangement of parts or the loads imposed upon them, or interfering with the current use of the bridge. A preference will be given to those designs which make the future addition of the second track an integral part of the plan.

"2. Two roadways for carriages, extending from Third Avenue to the high ground on the Long Island side, each 10 feet wide, which shall preferably be placed side by side, and which may be placed on the ground beneath the trestle carrying the railway from Third Avenue to Second Avenue, on the New York side, and from the foot of the grade (as shown in the profile) to the high ground on the Long Island side.

"3. Two side-walks, each 5 feet wide, extending either alongside or overhead of the main carriage-ways or the railway, but not along the auxiliary return approaches."

The specifications give the weights imposed upon different lengths of track and which the structure must be designed to carry. These vary from 1,620 lbs. per lineal foot for lengths of 700 to 800 feet up to 5,000 lbs. for lengths of 15 feet, for the roadways a moving load of 75 lbs. per square foot, or of 750 lbs. per lineal foot upon each roadway 10 feet wide, for all spans up to 100 feet. For the long spans across the river, the moving load shall be assumed at 50 pounds per square foot, or 500 per lineal foot of roadway 10 feet wide. For the side-walks a moving load shall be assumed of 75 pounds to the square foot, or of 375 pounds per lineal foot upon each.

It will thus be seen that we have here a bridge with a clear span of 734 feet which must be designed to carry a moving load of 3,400 lbs. per lineal foot, to be erected over a river with swift currents 135 feet above the water, and to be done in such a way as not to interfere with navigation. It may therefore be safely stated that it will be one of the most gigantic specimens of bridge construction that has ever been carried out.

From a report which was prepared by Mr. Charles Bender, a well-known bridge engineer, at the request of the President and Executive Committee of the Bridge Company, we are permitted to give the plan proposed by him and the reasons which led him to recommend it.

The great span and height of the bridge and the necessity for erecting it without interfering with navigation make an ordinary truss impracticable, on account of the great expense due to the length of the span, and the difficulties of its erection. As the lower line of the bridge must be straight, or nearly so, the arch or bracket plans are also excluded.

Stiffened suspension bridges, fig. 2, supported by catenary cables, or of any of the forms which have been used of late years, are open to the objection that, notwithstanding the fact that their construction has been carefully investigated, and that it is now possible to calculate at least approximately the strains to which their various members are subjected, nevertheless, owing to the combination of two systems necessary to give such bridges the requisite rigidity, it is impossible to know with certainty whether the two will always act together and each do the proportion of the work for which it is calculated. Besides this, up to the present time no railroad suspension bridge of so long a span has ever been built

PROFILE OF GRADES, NEW YORK & LONG ISLAND BRIDGE.

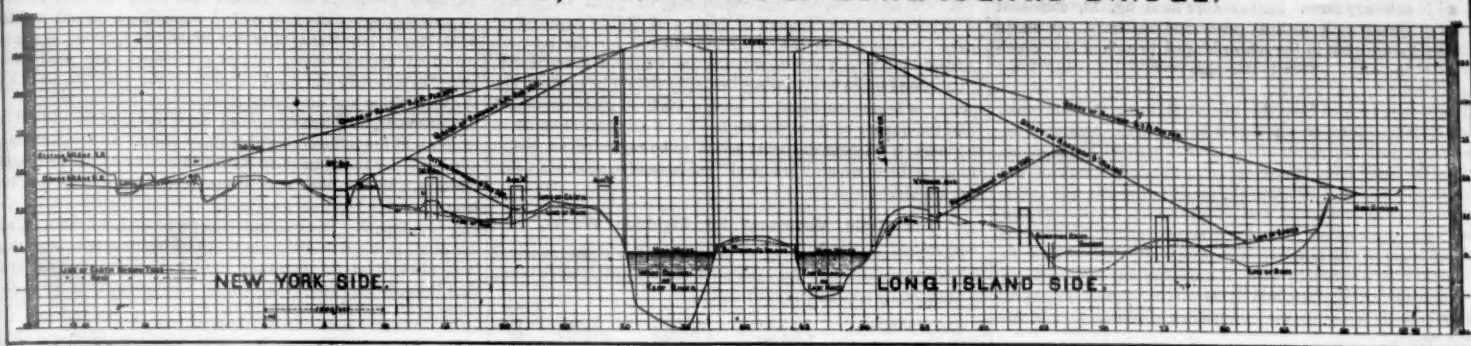


Fig. 1.



Fig. 2.

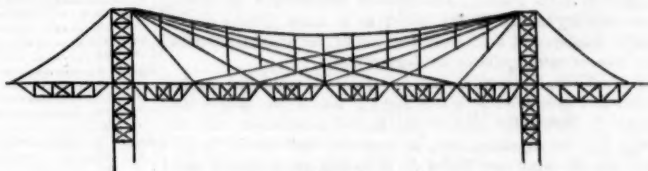


Fig. 3.

with sufficient rigidity to enable trains to pass over excepting at slow speeds, and it is considered impossible to give them the rigidity either vertically or horizontally which can be secured by a system with web posts.

Straight chain suspension bridges similar to what is known as the Whipple* or Ordish suspension plan, fig. 3, would not in such a locality be found to be economical. In this the whole length of the span is made up of a series of short spans which are supported at their ends by two straight cables, chains or rods, one of which is attached to each tower. These chains are supported from a catenary chain or cable to prevent them from sagging and vibrating unnecessarily. These short spans and the chains which support them will each be subjected to very nearly the maximum concentrated load, and therefore the whole of the bridge must be proportioned as though it were loaded over its whole length with the same load that the short spans will be subjected to. It is an established principle in bridge-building that a higher factor of safety is required to carry a moving than a dead or permanent load. In the Ordish system, the dead load of these short spans is much less in proportion to the moving load than it is in longer spans, and therefore all the parts must not only be proportioned for carrying a greater load per lineal foot, but the material of which they are constructed cannot, or should not, be calculated to carry so much load per square inch of section as it might safely bear if the proportion of the live to the permanent load were less, or, in other words, the parts must carry a greater load and must be made stronger in proportion to that load than they need be for longer spans. It is also impossible to secure as much rigidity with this system as with one having vertical posts, and as much as is needed for a railroad bridge, because when one of the short spans of the bridge is loaded, none of the weight is transferred to the adjoining systems un-

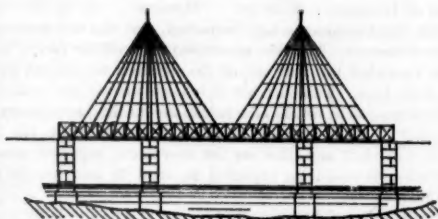


Fig. 4.

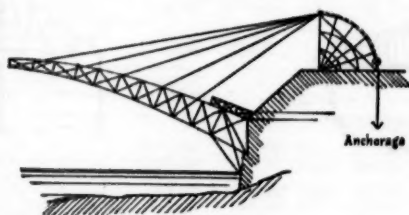


Fig. 5.



Fig. 6.

across the Straits of Menai by the system shown in fig. 5 and described in Navier's and Drewry's books on bridges.

In 1817 the King's Meadows bridge across the Tweed was built by Redpath & Brown, of Edinburgh. This is shown in fig. 6. It also consisted of a continuous rectangular truss supported by straight chains or rods. This, too, is described in Navier's and Drewry's books.

In 1834 Mr. A. Canfield, of Paterson, N. J., proposed what he called his "iron tension bridge," fig. 7, which was illustrated in the "American Mechanics' Magazine," of July, 1833, and from which our engraving is copied. This embodies the germs of some of the best features of the canti-lever system, which will be explained hereafter. It will be seen that it consisted of a truss attached to and built out from each abutment and these two ends united by a short central span which was in reality hinged or jointed to the ends of the canti-levers. The latter were anchored to the abutments.

In 1859-60, Langer, in Austria, proposed many new designs on the canti-lever principle, among which was one with a central hinge or joint, fig. 8. It consisted of two trusses resting on piers and supported by catenary cables which passed over the tops of towers erected on the piers. The cables were divided in the centre of the span, and the tension of one part of the cable, instead of being balanced or resisted by that on the other part, was transferred to the trusses at the centre of the bridge, and produced a compressive strain on the top and bottom chords of the trusses.

In 1864 the double swing bridge on Oudry's patent, fig. 9, was built at Brest. It is of 390 ft. span and is the largest draw span on the canti-lever plan. Previous to this draw-bridges in wood and iron had been built on this plan all over Europe. Bridges of this kind, it will be seen, have practically a central hinge or joint, that is are separated in the centre in such a

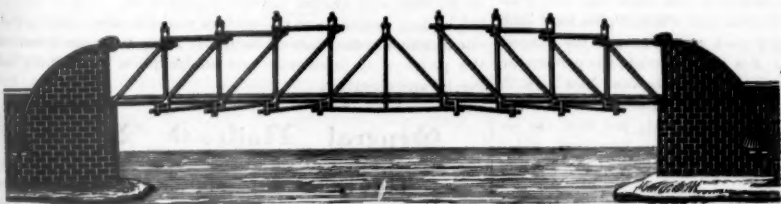


Fig. 7.

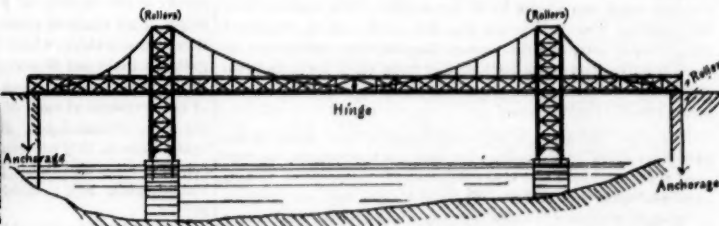


Fig. 8.



Fig. 9.

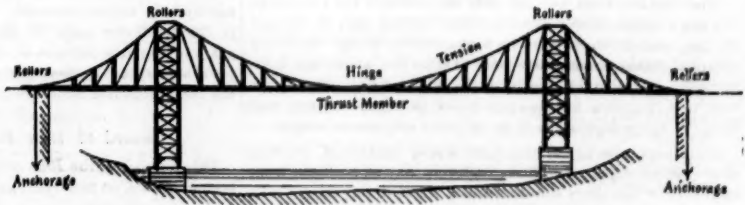


Fig. 10.

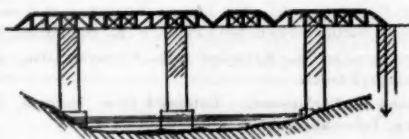


Fig. 11.

less the trusses which rest on the suspension rods are made in the form of a continuous girder. If this is done, the difficulty is incurred, to which we have already referred, of two systems working together, and the impossibility of knowing what proportion of the load is carried by each.

For the above reasons none of the plans described have been recommended in the report referred to, but what is known as the canti-lever system has been proposed.

The general features of this plan are old. About the beginning of this century Poyet proposed the plan for a bridge represented in fig. 4. This might more properly be called the derick plan. It consisted of a rectangular continuous girder which was supported by rods or chains attached to the tops of

* This plan, similar in every respect to what has since been called the Ordish system, was proposed by Mr. S. Whipple, C. E., in his "Work on Bridge Building," published in this country in 1847, in which may be found an engraving and full description of it.

towers erected on piers. The difficulty with this, and with all similar plans, is that it is practically impossible to make each of the two systems, that is the truss and the suspension rods, bear its proportion of the load. If they do not, one or the other will be overloaded. This plan was described in Navier's book on suspension bridges in 1823.

In 1811 Telford proposed to erect a cast-iron arch bridge

way that the one half of the central span, or one canti-lever, can deflect independently of the other, although usually measures were adopted to prevent this.

In the same year, 1864, Sedley patented in England a bridge which was attached to and erected from the abutments but united rigidly in the centre.

In 1865 Young in England introduced one hinge in the centre, fig. 10, and the same year de Berge patented in England the middle span, fig. 11, which was attached to the canti-levers at each end by flexible hinges or joints in a similar manner to the plan proposed in this country by Canfield in 1834.

In 1866 Gerber, in Bavaria, patented canti-lever bridges with an independent central span, as shown in fig. 11.

In 1867, Mr. Charles Bender patented in this country canti-lever bridges with one or more hinges and with vertical anchorage. One plan described in his patent con-

sisted of a stiffened bottom chord suspended to a catenary cable, fig. 2. Another, fig. 12, a stiffened top chord in catenary form. Still another form, fig. 13, consisted of a web system with vertical posts and catenary top chord with a separate span in the centre hinged to each of the cantilevers at the ends. This is the plan proposed for the Long Island Bridge.

It will thus be seen from this historical review that the cantilever system is not new, but that it has been, like nearly all human inventions, the result of a process of gradual development. One of the chief difficulties in applying the early forms of the system was that of calculating the strains to which the different members are subjected, and of providing for the expansion and contraction of the lower chord. This is accomplished by the central joints, which allow one side of the bridge to deflect vertically without imposing any of its load on the other half of the span, and by means of such a joint provision is easily made for the expansion and contraction of the lower chord.

If a post web system is employed between the top and bottom chords, the strains are then reduced to those of a simple truss supported in the centre. This form of construction gives the same rigidity as an ordinary truss, as a much greater depth can be employed at the towers than would be practicable with any form of rectangular or bow-string truss.

It is evident, however, if only one joint is employed in the centre as represented in figs. 10 and 12, that if one side of the bridge is loaded, the end of the loaded cantilever will be lower than the adjoining one, as much as the former is deflected by the load, and therefore it causes an awkward mechanical difficulty in a railroad bridge, inasmuch as the tracks on the two halves of the bridge will not be of the same height. Besides, a joint which will permit of free vertical deflection and longitudinal expansion of the lower chord, and at the same time give transverse stiffness, presents some difficult mechanical problems. These are all overcome by the use of a short central span which is hinged at each end, but with some kind of provision at one or both ends to allow for expansion and contraction. It will permit the end of either cantilever to deflect independently of the other and the middle span provides an inclined plane which forms an approach from the loaded to the unloaded cantilever.



Fig. 12.

levers. Besides, this short span if properly proportioned is more economical than longer cantilevers would be and gives greater lateral stiffness; but to give the reasons for this economy would lead us into more abstruse investigations than there is either time or place for here. The short span also diminishes the cost and risk of erection. This plan, fig. 13, is also claimed to be more economical than any form of rectangular or bow-string system, from the fact that the greatest weight of the bridge is concentrated near the piers, and therefore the strains which this weight produces or the "moments" are less than they would be if the weights were carried near the centre. The web posts, too, are subjected to strains of compression only, and the tension diagonal bars run in one direction only, that is, they all incline from their lower ends towards the towers, or in other words, there are no counter strains on the cantilevers.

This plan also gives a very economical form of truss for the two short spans between the piers and the approaches, the vertical posts of which are also subjected to compressive strains only, and both they and the diagonal tension bars are subjected to their maximum strains not only when the live load moves from the anchorage towards the tower, but also when the outer span is wholly loaded.

It will be observed that the only strain which the anchorage of such a bridge must resist is a direct vertical pull of the end of the cantilever, whereas in a suspension bridge there is a diagonal strain tending not only to slide the anchorage horizontally, but also to overturn the whole mass. Much less weight is therefore necessary to resist the direct vertical pull than the diagonal tension of an ordinary suspension bridge.

A cantilever bridge of this form is also capable of erection at very small expense. The cantilevers may be built out from each side of the piers simultaneously without any false-works whatsoever, and when the shore end reaches the anchorage it is secured to it, so that the short central span can be either rolled out from one of the cantilevers, or it can be erected in place by means of temporary suspension cables from one cantilever to the other. It is proposed to make the top chord of the short span slightly curved, so as to conform to the curve of the top of the cantilevers. In erecting the middle span, its top chord may be suspended by sham bracing, shown in dotted lines in fig. 13, from the ends of the cantilevers until the construction of this short span is completed. This temporary bracing will then be left in position in order to make the bridge look symmetrical, and to avoid the appearance of a break of continuity.

The above reasons for recommending this plan of bridge are those which have been given by Mr. Bender, who has given a great deal of time and ability to its investigation and study, and are in no sense to be considered as a judicial expression of opinion. The work is too important and the problem entirely too difficult to justify us, in its present stage, when some of the ablest engineers are at work on it, to attempt even to express

any final opinion of what would be the best plan for the location.

We will add, however, that considering the great magnitude of the work and the amount of time and ability required to make a proper design, the premiums offered for the best are absurdly small, and will hardly pay the wages of a draftsman, if he should make the drawings as they should be made. The quality of brains employed in such a work is more important than the quality of iron, yet the one has a recognised value in the market, whereas the other seems to be regarded as something mythical which "practical" business men need not value very highly.

The Grain Movement for Eighteen Weeks.

The shipments of grain of all kinds from the eight principal Northwestern markets for each week since April 22 have been, in bushels, by lake and by rail:

Week ending—	By lake.	By rail.	Total.	Per cent. by rail.
April 29.....	1,634,541	2,072,946	3,707,487	56
May 6.....	2,445,191	2,292,930	4,738,121	48½
" 13.....	1,538,524	2,302,940	3,841,466	60
" 20.....	1,602,170	2,016,304	3,618,474	55½
" 27.....	1,747,408	1,820,456	3,567,864	51
June 3.....	2,412,162	1,797,922	4,210,084	42½
" 10.....	2,894,915	2,147,670	5,042,585	42½
" 17.....	2,921,405	2,391,811	5,313,216	45
" 24.....	2,728,706	2,198,054	4,926,760	44½
July 1.....	1,821,155	1,784,548	3,605,703	49½
" 8.....	1,765,010	1,205,184	2,970,194	40½
" 15.....	1,648,508	1,228,678	2,877,186	42½
" 22.....	2,269,836	1,032,825	3,302,661	31½
" 29.....	1,466,502	1,038,208	2,504,710	41½
Aug. 5.....	2,055,243	1,383,208	3,438,451	38½
" 12.....	1,744,059	1,300,730	3,044,779	42½
" 19.....	2,150,292	1,614,256	3,764,548	42½
" 26.....	2,362,152	1,620,811	3,982,963	39½
Total for 18 weeks.....	37,197,281	31,049,234	68,246,515	45½

The total shipments have increased, but the rail shipments have decreased. The lake movement is decidedly large, have been exceeded but five out of the eighteen weeks, and not at all since June. This increase in lake shipments has doubtless caused the recent rise in lake rates, amounting, apparently, to one-third. This increase in rates, however, came too late to have much if any effect on the movement reported above; naturally, it would be expected to tend to increase the rail shipments.

For the same eighteen weeks receipts at Atlantic ports were:

	Corn.	Per cent. of total.	All grains.	Per cent. of total.
New York.....	10,465,116	29.0	31,277,632	44.6
Boston.....	3,923,173	10.9	8,268,672	7.6
Portland.....	332,100	0.9	667,510	1.0
Montreal.....	1,903,475	5.3	7,487,960	10.7
Philadelphia.....	9,677,000	26.8	19,409,050	19.1
Baltimore.....	8,273,900	22.9	10,003,985	14.2
New Orleans.....	1,521,859	4.2	2,087,971	2.9
Total.....	36,096,633	100.0	70,172,860	100.0

In corn receipts (for some months the chief business) New York, Boston and Montreal have improved their positions, chiefly at the expense of Philadelphia and Baltimore. In receipts of all kinds of grain, however, New York has lost position considerably, while Boston and Philadelphia have each gained a little and Montreal a good deal, it having the largest wheat receipts of the week. For the last week, the percentage of corn receipts at each of the leading ports was: New York, 38 per cent.; Philadelphia, 21½ per cent.; Baltimore, 16½ per cent.; Boston, 13 per cent.; Montreal, 11½ per cent. In receipts of all grains these percentages were: New York, 32½; Philadelphia, 20½; Montreal, 16½; Baltimore, 16; Boston, 10½.

If anything is noticeable in the report for the week, it is the small proportion of wheat received at New York—only 30 per cent. But the whole wheat movement is so small that this can hardly have any significance. It is to be borne in mind that it is the Southern ports of the grain districts that first send grain of the new harvest to market, and that the Southern ports are nearest to these parts. Moreover, little grain reaches the lakes from this Southern grain country.

Record of New Railroad Construction.

This number of the *Railroad Gazette* has information of the laying of track on new railroads as follows:

Connecticut Central.—The *Rockville Branch* is completed from East Windsor, Conn., east to Rockville, 7 miles.

New York & Canada.—The *Rouse's Point Branch* is extended 9 miles northwest to Rouse's Point, N. Y., completing it.

Wisconsin Central.—Extended from Worcester, Wis., north to Phillips, 7 miles.

Omaha & Northwestern.—Extended from Herman, Neb., north to Tekamah, 7 miles.

Covington, Columbus & Black Hills.—Extended 20 miles westward, to Ponca, Neb. It is of 3 ft. 6 in. gauge.

Southern Pacific.—The *Los Angeles Division* is completed and connected with the Tulare Division and San Francisco by the laying of 85 miles of track southward to and through the San Fernando Tunnel.

This is a total of 135 miles of new railroad, making 1,388 miles completed in the United States in 1876, against 678 miles reported for the same period in 1875, 984 in 1874, 2,408 in 1873 and 4,264 in 1872.

THE TRANSPORTATION AND COMMERCIAL EXPERTS appointed by the Secretary of the Treasury to furnish information to the department include in their number Mr. Albert Fink, late General Superintendent of the Louisville & Nashville Railroad, and Mr. J. D. Hayes, late Manager of the Blue Line. These are most excellent appointments, as the gentlemen have had many years' experience, and what is more to the purpose, have had the disposition and the ability to observe closely the phenomena of transportation business and to draw conclusions as to their causes and the influences which affect them. Other gentlemen appointed for the same purpose are officers of commercial associations, and the like, who are in position to know how the transportation business as actually carried on affects the interests of shippers. The railroad experts named, by the way, are not at all inclined to maintain that railroad business is all that it should be: on the contrary they have heretofore declared that it needs important reforms, in the interests of both the proprietors and the patrons of the railroads.

THE SOUTHERN PACIFIC RAILROAD has been completed so as to form a continuous railroad line from San Francisco southward to Los Angeles through the great fruit-growing districts of California, and thence east by south towards the Colorado River and the Arizona border, which it now approaches within a hundred miles. This for the first time unites the railroad system of Southern California with San Francisco and the rest of the California railroad system. The Southern Pacific now has passed through the whole extent of the cultivatable part of Southern California, the territory between the present terminus and the Colorado being a desolate desert, which, however, has the advantage of requiring a very slight amount of work for the construction and maintenance of a road-bed—no hills, no streams, no rain. Over this section it is reasonable to suppose that most of the Arizona traffic will pass, which, though not now very large in amount, may be made quite profitable. This railroad and the Cincinnati Southern are the longest lines now under way.

NEW PUBLICATIONS.

Mr. James M. Swank, Secretary of the American Iron and Steel Association, has compiled and the Association has published a volume of 200 pages entitled "The American Iron

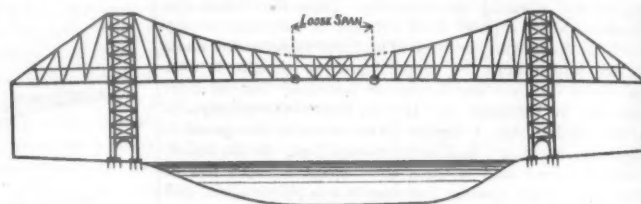


Fig. 13.

Trade in 1876," being the annual report of the Association for the Centennial year. A very large part of the work is devoted to a discussion of the policy of protection, the first 58 pages coming under the title of "The Industrial Policy of Great Britain," and the next 56 to "The Industrial Policy of the United States." This is followed by an interesting "Historical Sketch of the American Iron Trade," which a great many readers not especially connected with the iron industry will value. The statistics of the American trade follow, being similar (but fuller) to what has heretofore formed the main body of the report. These statistics are of decided value, forming as they do the best and almost the only record of the work of one of the leading industries of the modern world in this country, and one in which great waste of capital is likely to be made unless the progress of production and consumption is carefully recorded and observed.

General Railroad News.

ELECTIONS AND APPOINTMENTS.

Cairo & Vincennes.—The office of General Freight and Ticket Agent has been divided, Mr. Charles S. Sawyer remaining General Freight Agent, while Mr. F. A. Miller is appointed General Passenger Agent.

Fort Wayne, Jackson & Saginaw.—Mr. E. R. Parker is appointed General Freight Agent, with office at Jackson, Mich.

Indianapolis & St. Louis.—Mr. E. B. McClure is appointed General and Purchasing Agent in place of J. W. Morse, appointed General Manager of the White Line.

Kansas & Pacific.—Mr. Adolphus Meier has been chosen President in place of Robert E. Carr, resigned. Mr. T. F. Oakes has been chosen a director and Vice-President, with office in Kansas City, Mo.

Laurel Fork & Sand Hill.—The officers of the road are as follows: W. C. Stiles, Jr., President; H. O. Stiles, Treasurer; F. H. Williams, Secretary; D. C. Mudge, Superintendent. The offices are at Volcano, W. Va.

Mobile & Ohio.—A new arrangement of divisions and officers has been made as follows: The Southern Division will extend from Mobile, Ala., to Macon, Miss., 190 miles, and will be in charge of Assistant General Superintendent C. Fleming, with office at Mobile, Ala. The Northern Division will extend from Macon, Miss., to Columbus, Ky., 274 miles, and will be in charge of Division Superintendent E. S. Hosford, with office at Jackson, Tenn.

Atlantic & Great Western.—Mr. James Pitton, late Train Dispatcher, has been appointed Acting Superintendent First Division, in place of J. T. Odell, resigned.

Atlantic, Mississippi & Ohio.—The organization of the road under the Receivers is as follows: Charles L. Perkins, Henry Fink, Receivers; Frank Huger, Master of Transportation Virginia & Tennessee Division; N. M. Osborne, Master of Transportation South Side and Norfolk & Petersburg divisions; Jas. E. Cuthbert, Treasurer; M. C. Jameson, Cashier; E. E. Portlock, Auditor; W. E. M. Wood, Passenger Agent. The general offices are at Lynchburg, Va.

Toledo & Maumee.—In consequence of a recent change of ownership there have been several changes in the board of

directors, which is now as follows: William Taylor, W. J. Wells, H. Howard, G. W. Reynolds, J. McDonnell, M. W. Plain, H. S. Walbridge. Mr. Wm. Taylor has been chosen President and Superintendent in place of W. J. Wells, resigned.

Boston & New York Air Line.—Mr. J. E. Foster has been appointed General Passenger Agent, with office at No. 347 Broadway, New York.

Ontario Southern.—The officers of this road are now as follows: L. A. Milbank, General Manager; James Hardy, Superintendent; W. S. Turner, General Freight and Passenger Agent. The offices are at Sodus Point, N. Y.

Connecticut Valley.—Mr. George H. Griggs, late of the Keokuk & Des Moines, has been appointed Superintendent.

Pittsburgh Locomotive Works.—Mr. Weightman, lately connected with the Rhode Island Locomotive Works, has been appointed Superintendent, in place of Mr. J. Augustus Durgin, who has become Superintendent of the Rhode Island Works.

Hannibal & St. Joseph.—Mr. C. T. McIlvane has been appointed Master Mechanic in charge of the shops at Kansas City. He has for six years past been in charge of the Missouri, Kansas & Texas shops at Sedalia.

St. Louis & Southeastern.—The Court has directed General Superintendent R. H. G. Minty to act as Receiver, in place of J. F. Alexander, deceased, until a permanent appointment can be made.

Logansport, Crawfordville & Southwestern.—The following appointments have been made by the new Receiver, W. G. Brinson, late Master of Transportation, to be Superintendent; W. H. True, to be Treasurer, in place of W. P. Hams, resigned; T. S. McKinlay to be Roadmaster. J. E. Harris, General Freight and Ticket Agent, and W. D. Ernst, Auditor, are continued in their respective positions.

Texas & Pacific.—The following circular bears date Sept. 1: "1. H. W. Thompson Jr., has been appointed General Passenger and Ticket Agent of this company. All communications respecting the business of that department should be addressed to him at Marshall, Texas.

"2. J. S. Noble has been appointed Division Superintendent of the Jefferson and Southern Divisions of this railway, including that part of the line from Texarkana to Marshall and Shreveport to Fort Worth. All communications respecting the business of the divisions should be addressed to him at Marshall, Texas.

"3. H. T. Peake has been appointed Division Superintendent of the Trans-Continental Division of this railway, including that portion of the line between Texarkana Junction and Sherman. All communications respecting the business of the division should be addressed to him at Sherman, Texas."

Iowa Southern & Missouri Northern.—The first board of directors of this new company is as follows: R. R. Cable, T. H. Griggs, E. E. Cook, J. Scott Richman, J. L. Drew, H. H. Hills. This board has chosen F. H. Griggs Secretary and J. L. Drew, Treasurer. The office is in Davenport, Ia.

European & North American.—The New Brunswick Court has appointed James Murray Kay and E. R. Burpee Receivers of so much of this road as lies in the Province of New Brunswick.

Union Railroad Transfer & Stock Yard Co.—This company has been organized in Indianapolis by the election of the following directors: John Thomas, W. R. McKen, W. C. Holmes, Horace Scott, J. C. Ferguson, E. F. Claypool, M. A. Downing, J. F. Miller, W. N. Jackson. The board elected W. R. McKen President and John Thomas Secretary.

Colchester.—This new company has been organized by the election of the following officers: W. H. Hayward, President; G. G. Wickwire, Treasurer; Ira A. Dinamore, Secretary. The company's office is at Colchester, Conn.

Internal Commerce and Transportation Commission.—In pursuance of an act passed by Congress at its late session, the Secretary of the Treasury has appointed the following gentlemen a Commission for the purpose of reporting to the Treasury Department information with regard to internal commerce and transportation: Hamilton A. Hill, Boston; Theodore F. Lees, New York; George W. Porter, Baltimore; Albert Fink, Louisville, Ky.; Geo. H. Morgan, St. Louis; J. D. Hayes, Detroit, Mich.; Charles Randolph, Chicago, and Milo Smith, Clinton, Ia.

PERSONAL.

—Connecticut Republicans have nominated for Governor Mr. Henry C. Robinson, of Hartford, a director of the New York, New Haven & Hartford Company, and for Lieutenant Governor Mr. Frederick J. Kingsbury, of Waterbury, who is a director of the New York & New England.

—Mr. Joseph W. Sprague, for many years President of the Ohio Falls Car Company, of Jeffersonville, Ind., has accepted the position of President of the St. Charles Manufacturing Company, at St. Charles, Mo.

—Mr. C. F. Barron, Commercial Agent of the Michigan Central at Detroit, was recently offered the position of General Freight Agent of the Peoria, Pekin & Jacksonville road, but declined it.

—Mr. J. F. Alexander, for two years past Receiver of the St. Louis & Southeastern Railroad in Illinois, Indiana and Tennessee, a director of the company from its first organization and at one time Vice-President, died at his residence in Greenville, Ill., Aug. 26. He was about 60 years of age.

—Mr. Robert E. Carr has resigned his position as President of the Kansas Pacific Railway Company on account of continued ill health.

TRAFFIC AND EARNINGS.

Railroad Traffic.

The shipments of through freight eastward over the Central Pacific Railroad during July were as follows:

	1876.	1875.	Inc. or Dec.	P. c.
San Francisco, tons.....	3,585	4,184	Dec.. 599	14.3
Interior points.....	631	327	Inc.. 304	93.0
Total.....	4,216	4,511	Dec.. 295	6.5

The leading items this year were wool and fruit.

Erie Canal Tolls.

The business of the canal at Buffalo from the opening up to Aug. 21 was as follows:

	1876.	1875.	Decrease.	P. c.
Boats cleared.....	2,722	3,436	714	20.8
Tolls received.....	\$322,008 51	\$420,017 23	\$98,013 72	23.3

The canal opened May 4 in 1876, and May 18 in 1875.

Ocean Freight.

New York to Liverpool by steam, 8d. per bushel on grain, 50c. per ton for butter and cheese, 40c. for bacon; by sail, 3c. per barrel for flour. By sail to Cork for orders, 9d. to 9½d. per bushel for grain, and 5c. 6d. for petroleum.

Lake and Canal Rates.

Rates by lake are firmer, most cargoes during the past week apparently having been taken at 2½ cents per bushel for corn from Chicago to Buffalo. At the close of last week vessels were making 2½. The quotations for Tuesday of this week, as telegraphed, were 2½ cents for wheat and 2 for corn. Canal rates Sunday, from Buffalo to New York, were 5½ cents per bushel

for wheat, 5½ for corn and 3½ for oats. The through lake and rail rate from Chicago to New York is 11 cents for wheat, 10 for corn and 7½ for oats.

Railroad Earnings.

Earnings for various periods are reported as follows:

Eight months ending Aug. 31:

	1876.	1875.	Inc. or Dec.	P. c.
Atchison, Topeka & Santa Fe.....	\$1,476,265	\$840,950	Inc.. \$635,355	75.5
Chicago & Alton.....	3,149,643	2,912,371	Inc.. 237,272	8.1
Chicago, Milwaukee & St. Paul.....	5,215,277	4,865,362	Inc.. 349,925	7.2
Michigan Central.....	4,438,883	4,196,197	Inc.. 242,686	5.8
Toledo, Peoria & Warsaw.....	929,502	631,745	Inc.. 297,757	47.1
Ohio & Mississippi.....	2,388,313	2,085,991	Inc.. 302,322	14.5
St. Louis, Iron Mountain & Southern.....	2,261,186	2,153,147	Inc.. 108,039	5.0
St. Louis, Kan. City & Northern.....	1,973,357	1,634,219	Inc.. 339,138	20.8

Seven months ending July 31:

	1876.	1875.	Inc. or Dec.	P. c.
Atchison, Topeka & Santa Fe.....	\$1,244,654	\$689,127	Inc.. \$555,527	80.6
Expenses.....	640,233	329,387	Inc.. 310,846	94.4
Net earnings.....	\$604,421	\$359,740	Inc.. \$244,678	68.0
Per cent. of expenses.....	57.44	47.78	Inc.. 3.66	7.7
Cleveland, Mt. Vernon & Delaware.....	211,786	240,767	Dec.. 28,981	12.0
Louisville, Cincinnati & Lexington.....	601,246	.....	.....	.....
Expenses.....	447,548	.....	.....	.....
Net earnings.....	\$153,698	.....	.....	.....
Per cent. of expenses.....	74.44	.....	.....	.....
Louisville & Nashville.....	2,754,828	\$2,545,796	Inc.. \$209,032	8.2
Paduash & Memphis.....	119,095	103,904	Inc.. 15,191	14.6

Month of June:

	1876.	1875.	Inc. or Dec.	P. c.
Denver & Rio Grande.....	\$33,333	\$34,767	Dec.. \$1,434	4.1
Expenses.....	19,089	19,853	Dec.. 764	8.9
Net earnings.....	\$15,244	\$14,914	Inc.. \$330	2.2
Per cent. of expenses.....	54.28	57.05	Dec.. 2.77	4.9

Month of July:

	1876.	1875.	Inc. or Dec.	P. c.
Atchison, Topeka & Santa Fe.....	\$198,851	\$113,480	Inc.. \$85,401	77.2
Expenses.....	110,913	47,867	Inc.. 63,046	131.6
Net earnings.....	\$87,938	\$65,693	Inc.. \$22,245	34.1
Per cent. of expenses.....	55.77	42.38	Inc.. 13.35	32.1
Cleveland, Mt. Vernon & Delaware.....	27,585	34,772	Dec.. 7,187	20.7
Louisville, Cincinnati & Lexington.....	95,605	79,798	Inc.. 15,807	19.8
Expenses.....	67,445	68,824	Dec.. 1,379	2.0
Net earnings.....	\$28,160	\$10,974	Inc.. \$17,186	156.2
Per cent. of expenses.....	70.55	86.25	Dec.. 15.70	18.2
Paduash & Memphis.....	19,041	12,026	Inc.. 7,015	8.5
Net earnings.....	\$100,221	.....	.....	.....
Expenses.....	59,704	.....	.....	.....
Net earnings.....	\$40,520	.....	.....	.....
Per cent. of expenses.....	67.88	.....	.....	.....

Month of August:

	1876.	1875.	Inc. or Dec.	P. c.
Atchison, Topeka & Santa Fe.....	\$231,549	\$151,823	Inc.. \$79,726	52.5
Chicago & Alton.....	494,272	411,960	Inc.. 82,312	20.0
Chicago, Milwaukee & St. Paul.....	560,482	630,516	Dec.. 61,034	9.7
Michigan Central.....	542,772	534,000	Inc.. 8,772	1.6
Toledo, Peoria & Warsaw.....	143,471	113,013	Inc.. 30,458	27.0
Ohio & Mississippi.....	292,898	297,771	Dec.. 4,873	1.6
St. Louis, Iron Mountain & Southern.....	288,300	289,967	Dec.. 1,667	0.6
St. Louis, Kan. City & Northern.....	255,088	249,836	Inc.. 5,252	2.1
Third week in August:	.....	.....	.....	.....
Denver & Rio Grande.....	\$6,413	\$7,116	Dec.. \$703	9.9
Main Line.....	.....	.....	.....	.....
Denver & Rio Grande.....	2,071	.....	.....	.....
Trinidad Extension.....	.....	.....	.....	.....
Missouri, Kansas & Texas.....	63,959	71,994	Dec.. 8,035	11.2

Grain Movement.

Receipts and shipments of grain of all kinds for the week ending Aug. 26 are reported as follows, in bushels:

	1876.	1875.	Inc. or Dec.	P. c.
Lake ports' receipts.....	4,278,052	4,420,986	Dec.. 142,934	3.2
Lake ports' shipments.....	3,872,963	3,146,585	Inc.. 726,378	23.1
Atlantic ports' receipts.....	3,227,692	1,654,312	Inc.. 1,573,380	95.8

Of the shipments from lake ports 39½ per cent. was by rail this year, against 32½ per cent. for the same week in 1875 and 19½ per cent. in 1874. Compared with the previous week, there is an increase in the movement all around. The wheat movement continues very light, the receipts at lake ports being the smallest for seven years.

Chicago receipts and shipments for the week ending Sept. 2, were:

	1876.	1875.	Inc. or Dec.	P. c.
Receipts.....	2,494,093	2,126,492	Inc.. 367,601	17.3
Shipments.....	1,834,002	2,909,186	Dec.. 1,075,184	36.9

The receipts are the largest for seven weeks. The shipments are smaller than for the two preceding weeks. Only 120,000 bushels of the receipts were wheat.

Baltimore receipts for August were as follows:

	1876.	1875.	Inc. or Dec.	P. c.
Flour, barrels.....	129,062	115,380	Inc.. 13,682	11.9
Wheat, bushels.....	628,208	702,831	Dec.. 74,623	10.9
Corn.....	1,872,225	624,842	Inc.. 1,247,383	191.7
Other grain.....	121,638	114,638	Inc.. 7,000	5.9
Total, bushels.....	2,806,777	1,961,586	Inc.. 845,191	47.7

For the eight months ending Aug. 31 the receipts were as follows:

	1876.	1875.	Inc. or Dec.	P. c.
Flour, barrels.....	899,340	928,906	Dec.. 29,566	3.4
Grain, bushels.....	20,467,278	10,101,227	Inc.. 10,366,051	102.6
Total, bushels.....	24,467,308	14,280,854	Inc.. 10,206,454	71.5

Buffalo flour and grain receipts for the eight months ending Aug. 31 were as follows, flour in barrels and grain in bushels:

	1876.	1875.	1876.	1875.
By lake.....	387,084	575,867	24,198,965	27,008,701
By rail.....	747,400	418,600	9,016,000	5,538,600
Totals.....	1,134,484	994,467	33,214,965	32,547,301

The increase in flour this year is 14.1 per cent.; in grain, 8.2 per cent. Of the flour 65.9 per cent., and of the grain 27.2 per cent. came by rail this year. Shipments eastward of grain for the same period were as follows:

	1876.	1875.	Inc. or Dec.	P. c.
By rail, bushels.....	7,741,187	8,339,074	Dec.. 597,887	7.1
By canal.....	15,416,828	17,956,284	Dec.. 2,539,456	14.1
Totals.....	23,158,015	26,295,358	Dec.. 3,137,343	11.9

The rail shipments were 33.4 per cent. of the whole this year, and 31.7 per cent. in 1875. The canal was open two weeks longer this year than last.

Coal Movement.

Reports of coal tonnage for the eight months ending Aug. 29 are as follows:

	1876.	1875.	Inc. or Dec.	P. c.
Anthracite:				
Philadelphia & Reading.....	2,534,087	2,221,152	Inc.. 312,935	15.0
Northern Central, from Shamokin Div. and Summit Branch.....	500,453	788,272	Dec.. 287,819	36.5
Danville, Hazleton & Wilkesbarre.....	27,297	48,864	Dec.. 21,567	44.1
Central of N. J., Lehigh Div.....	1,513,613	939,365	Inc.. 574,248	61.1
Lehigh Valley.....	2,146,064	1,422,001	Inc.. 724,063	50.9
Pennsylvania & New York.....	17,488	72,923	Dec.. 55,435	76.0
Pennsylvania Canal.....	238,319	128,632	Inc.. 109,687	85.3
Delaware, Lackawanna & Western.....	905,780	2,044,569	Dec.. 1,138,789	55.7
Delaware & Hudson Canal Co.....	1,121,330	2,065,164	Dec.. 943,834	45.7
State Line & Sullivan.....	27,500	5,557	Inc.. 21,943	394.9
Pennsylvania Coal Co.....	582,132	868,284	Dec.. 286,152	33.0
Total anthracite.....	9,634,063	10,604,783	Dec.. 970,720	9.2

Semi-bituminous:

	1876.	1875.	Inc. or Dec.	P. c.
Cumberland, all lines.....	1,132,687	1,483,573	Dec.. 350,886	23.7
Huntingdon & Broad Top.....	102,518	143,045	Dec.. 40,527	28.3
East Broad Top.....	46,346	29,409	Inc.. 16,937	87.2
Tyone & Clearfield.....	774,380	568,343	Inc.. 211,037	37.5
Bellefonte & Snow Shoe.....	34,660	43,482	Dec.. 8,822	20.3
Total semi-bituminous.....	2,090,591	2,267,812	Dec.. 177,221	7.6

Bituminous:

	1876.	1875.	Inc. or Dec.	P. c.
Barclay R. R.....	213,441	145,285	Inc.. 68,156	46.9
Allegheny Region, Pa. R.R.....	136,431	148,273	Dec.. 11,842	8.7
Penn and Westmoreland gas coal.....	506,599	406,411	Inc.. 100,188	24.7
Pittsburgh Region, Pa. R.R.....	166,722	.....	.....	.....
Western Pennsylvania R.R.....	129,082	403,172	Dec.. 274,090	17.2
Southwest Pennsylvania R.R.....	38,119	.....	.....	.....
Total bituminous.....	1,180,394	1,109,141	Inc.. 71,253	7.8

Coke:

	1876.	1875.	Inc. or Dec.	P. c.
Penn and Westmoreland.....	31,806	.....	.....	.....
Western Pennsylvania R.R.....	30,457	.....	.....	.....
Southwest Pennsylvania R.R.....	327,534	354,722	Dec.. 27,188	2.2
Pittsburgh Region, Pa. R.R.....	110,866	.....	.....	.....
Total coke.....	501,663	454,091	Inc.. 47,572	10.5

The tonnage in each case is that originating on the line with which it is given, and does not include coal coming from other lines, so that the totals give the production of each kind of coal. The statistics are collected by the Engineering and Mining Journal.

The shipments of coal from Pictou, N. S., for the eight months ending Aug. 26 were 110,285 tons.

The coal-miners' strike in St. Clair County, Ill., continues and has extended to the mines at Murphysboro, Mount Carbon and Centerville, where production is now entirely suspended.

The coal traffic of the Belvidere Division, Pennsylvania Railroad, for the eight months ending Aug. 26 was as follows:

size, 46 1/2 ft. high and 12 1/2 ft. bush, and will use coal and ore from local mines.

How a Section-Master Solved a Problem.

The Port Jervis (N. Y.) *Gazette* says: "Each section-master upon the line of the Erie Railway is required to furnish his Division Superintendent with an account of all persons and animals killed or hurt within his jurisdiction, with all the particulars relating thereto, such as the cause of death or injury sustained and the disposition made of such killed or maimed. Necessary blanks are supplied to such persons, to be filled out in case of accident or casualty, which are to be forwarded immediately to headquarters."

"A few days since a cow was run down by a freight train on the Delaware Division and converted into fresh beef. Fortunately the train was not thrown from the track, and the carcass was removed and taken possession of by the owner."

"In pursuance of instructions, the section-master sat down and proceeded to fill out the necessary blank. He made good progress in his task until he came to the line 'what disposition,' and then the poor man was sorely puzzled. It was his first venture in the business, and he scratched his head vigorously for a short time. Suddenly a bright idea flashed through his brain, and, stretching out the sheet before him, he wrote with a rapid hand, 'mild and gentle!'"

"The hearty laughter evoked from the contents of the document when received at headquarters could not well be suppressed, and clerks and officials alike indulged in cachinnatory expressions suited to the occasion."

Sleeping Car Robbers.

The Cincinnati *Gazette* says: "A discovery was made recently on a sleeping car on the Little Miami Railroad, which lifts a heavy load of suspicion from the conductors and porters. It is always the case when a passenger in a sleeping car is robbed, that the porter or conductor first falls into disrepute. Then, if they are not found to be guilty, it is taken for granted that thieves are in some of the berths, and honest passengers are made uncomfortable by being suspected of being common thieves. A lady made the discovery above alluded to. She was awakened at a point where the train stopped for water, not at a station, by finding a man's hand rummaging her berth for valuables. She gave the alarm, but too late to catch the man, but in time to make the discovery that the thief was neither conductor, porter nor passenger, but a scoundrel who reached the open window of the berth from the outside, by standing on the chains or rods that stretch below the car, near the edge. It is not a comfortable position, but it enables an expert thief to make a pretty minute inspection of a sleeping berth, without entering the car. Moral, close your window when the train stops for water in a lonely place."

OLD AND NEW ROADS.

Atchison, Topeka & Santa Fe.

The operations of this road for July were as follows, the mileage worked being 711 miles:

Freight.....	\$123,121 15
Passenger.....	68,462 98
Express, mail and miscellaneous.....	7,267 22
Total earnings (\$280 per mile).....	\$198,851 35
Operating expenses (56.77 per cent.).....	110,913 16
Net earnings (\$124 per mile).....	\$87,938 19

As compared with July, 1875, when the mileage worked was 508 miles, there is an increase of 77.2 per cent. in gross, and of 31.4 per cent. in net earnings. For the seven months ending July 31, the report is as follows, the average mileage worked being 687 miles:

Freight.....	\$809,317 13
Passengers.....	388,763 26
Express, mail and miscellaneous.....	46,873 19
Total earnings (\$1,612 per mile).....	\$1,244,953 58
Operating expenses (61.44 per cent.).....	640,297 86
Net earnings (\$800 per mile).....	\$604,655 72

As compared with the same period in 1875, on 508 miles worked, there is an increase of 80.6 per cent. in gross and of 68 per cent. in net earnings. Working expenses were 47.78 per cent. of earnings in 1875.

Louisville, Cincinnati & Lexington.

The Auditor's report for July is as follows:

	1876.	1875.	1874.
Passenger earnings.....	\$42,044 57	\$35,815 99	\$35,448 57
Freight.....	47,196 82	37,676 62	55,062 25
Express, mail, etc.....	6,363 63	6,308 03	4,978 67
Total earnings.....	\$95,605 02	\$79,797 64	\$95,489 49
Ordinary expenses.....	\$59,163 80	\$60,102 40	\$71,718 22
Renewal of ties and rails.....	8,281 61	8,721 80	.....
Total expenses.....	\$67,445 41	\$68,824 20	\$71,718 22
Net earnings.....	\$28,159 61	\$10,973 44	\$23,771 27
State taxes.....	\$1,290 00	\$1,451 25	\$1,451 25
Rentals and guarantees.....	3,507 72	5,708 02	4,867 21
Construction and improvement.....	778 47	.....	1,338 21
Total.....	\$5,966 19	\$7,159 27	\$7,651 67
Net profit.....	\$22,193 42	\$3,814 17	\$16,119 60

Comparing this year with 1875, there is an increase of 19.8 per cent. in gross earnings, of 156.2 per cent. in net earnings, and of 483.7 per cent. in net profit. The earnings per mile this year were \$419; the expenses were 70.55 per cent. of earnings, against 86.25 per cent. last year and 75.10 per cent. the year before.

Chicago, Rock Island & Pacific.

This company recently began to erect a permanent wall to protect its tracks on Clark street in Chicago. The Lake Shore & Michigan Southern Company, which claims to own one-half the right of way there, applied for and obtained a temporary injunction to prevent the construction of the wall.

A dispatch from Leavenworth, Kan., says that the firemen on the Southwestern Division have struck, in consequence of an order discharging all wipers and throwing their work upon the firemen. The dispatch says further that several unsuccessful attempts to throw trains from the track had been made.

Pennsylvania.

A portion of the old Navy Yard property in Philadelphia is to be utilized this fall by the erection of storage warehouses for the reception of potatoes, apples and similar produce, in which a large business is done during the winter and for which the road has now no suitable accommodations.

Chicago, Danville & Vincennes.

In the suits brought to enforce various liens upon the 20 1/2 miles of road from Dalton to Chicago, now known as the Chicago & Southern road, and leased to this company, the United States Circuit Court has given a decision. A company known as the Chicago, Danville & Vincennes Railway Company was first organized to build the road and issued some bonds; subsequently the Chicago & Southern Company was organized,

took the work already done, and completed a part of the road. The court decides that the Chicago & Southern Company, in taking the work done and using it, took it subject to the lien of the mortgage made by the first company, and the holders of bonds issued by that company are adjudged to have a claim upon the property prior to that of the holders of Chicago & Southern bonds. Before all bonds, however, the court puts the lien of John B. Brown, the contractor who built the road. This lien is subject to an offset of about \$110,000, for rails furnished by the company, leaving Mr. Brown's claim about \$50,000, which is a first lien upon the property. The next claim, that of the holders of bonds issued by the company first organized, amounts to about \$100,000, without interest. A final decree in this matter waits the settlement of some minor points, and was to be issued this week.

Erie.

A report is revived to the effect that the main line of the Delaware Division is to be straightened and improved by building a line from Honesdale, Pa., to Lanesboro or Susquehanna. This, with the existing branch from Lackawaxen to Honesdale will make a new line from Lackawaxen to Susquehanna, which will be somewhat shorter than the old one, with better grades. The talk of a new line from Port Jervis east is also revived. Of course it is impossible to do anything of this kind in the present condition of the company.

Mr. Jewett, the President and Receiver, is expected to arrive in New York from England at the end of this week.

Denver & Rio Grande.

The operations of the Main Line (120 miles) for June were as follows:

Freight train earnings.....	\$18,201 22
Passenger train earnings.....	15,086 96
Miscellaneous.....	76 00
Total earnings (\$278 per mile).....	\$33,333 28
Expenses (54.28 per cent.).....	15,080 37
Net earnings (\$127 per mile).....	\$18,252 91

As compared with June, 1875, there is a decrease of 4.1 per cent. in gross, and an increase of 2.2 per cent. in net earnings. Of the earnings this year \$735.36 were from transportation of United States mails, troops and Government freight. There was \$394.25 for transportation of contractor's freight.

Dividends.

Dividends have been declared by the following companies:

Boston, Revere Beach & Lynn, 2 per cent., quarterly, payable Sept. 15.

Chicago, Burlington & Quincy, 5 per cent., semi-annual, payable Sept. 15.

Iowa Falls & Sioux City (was leased to Illinois Central), 1 1/2 per cent., semi-annual, payable Sept. 1.

Salem & Lowell (road leased to Boston & Lowell) 0 1/2 per cent., semi-annual, payable on demand.

Chicago, Milwaukee & St. Paul, 3 1/2 per cent., semi-annual, on the preferred stock, payable Oct. 5.

Meetings.

The following companies will hold their annual meetings at the times and places given:

Northern Pacific, at the company's office, No. 23 Fifth avenue, New York Sept. 27, at 11 a. m. Transfer books will be closed from Sept. 20 to Sept. 30.

Indianapolis, Bloomington & Western, at the office in Urbana, Ill., Sept. 13.

Northern, of Canada.

The Government Commission to investigate the affairs of this company is now sitting in Toronto, Ont. The meetings are held with closed doors, but it is said that evidence has already been received showing many payments for political election purposes and other doubtful transactions, besides money spent for purchase of steamboats and other objects beyond the powers of the company.

Miami Valley.

The contractor, Mr. John B. Benedict, broke ground for this road Aug. 31 at Avondale, near Cincinnati. A number of officers and friends of the road were present, and there were several speeches made. A considerable force is now at work on the grading, about 200 men being already employed.

Cincinnati & Eastern.

A considerable amount of grading has been done on this line, formerly the Cincinnati, Batavia & Williamsburg, and the iron is now being laid from Newtown, O., east to Batavia, a distance of about 20 miles. As soon as this section is completed it will be opened for business. The company is preparing to build a branch line from Newtown to Mount Washington and Withamsville.

Connecticut Central.

The last rail on the Rockville Branch was laid Aug. 31. The track is being ballasted and will soon be ready for trains. A connection with the Hartford, Providence and Fishkill's Rockville Branch, at Rockville, is to be made at once. The branch leaves the Main Line near East Windsor Hill and runs eastward seven miles to Rockville.

Southern Pacific.

The connection between the Tulare and Los Angeles divisions through the Tehachepa Pass and the San Fernando tunnel has been completed, and the first through train from San Francisco to Los Angeles passed over the line Sept. 5. The distance between the two places by rail is 460 miles, of which 82 miles is made up by the Central Pacific from San Francisco to Lathrop; 146 miles by the Central Pacific's Visalia Division, from Lathrop to Goshen, and 232 miles by the Southern Pacific, from Goshen to Los Angeles. The line just completed through the Tehachepa and San Fernando passes was an extremely difficult and expensive one to build, requiring besides the San Fernando tunnel, which is 6,966 feet long, a number of shorter tunnels and much rock cutting and other costly work.

Beyond Los Angeles the track is laid for 150 miles east by south towards the Colorado River, so that the company now has a continuous line 382 miles long from Goshen to the end of the track. In addition to this the Northern Division—which is yet to be connected with the Los Angeles line—is 143 miles long, and the company owns three short branches, 61 miles in all, so that it now owns 586 miles of completed road. The terminus of the Main Line is 610 miles by rail from San Francisco.

Florida.

Since the report made by the Amsterdam bondholders' committee last fall, nothing has been done, the bondholders probably regarding the property as worthless and being indisposed to spend any more money. The road was built with the expectation—at any rate such was the claim of its projectors—that a large traffic would pass over it between the Atlantic and the Gulf of Mexico. This expectation was not realized, and the business of the road has always been very small.

Toledo, Peoria & Warsaw.

A plan has been prepared for the reorganization of this company, which is said to have the approval of some large holders of securities. It provides for the funding of four coupons from the first-mortgage bonds of both divisions, seven from the Bur-

lington Branch bonds, and eleven from the second-mortgage and consolidated bonds, the first-mortgage bondholders to receive for their coupons new funded coupon bonds having 15 years to run, and the other bondholders to take preferred stock for their coupons. It also provides for the exchange of new common stock for 25 per cent. of the present first preferred and 75 per cent. of the second preferred stock, such preferred stock to be reissued in exchange for funded coupons as above, and also for floating debt claims and judgments. The plan is evidently in the interest of the stockholders and owners of the subordinate securities; whether it will meet the approval of the first-mortgage bondholders remains to be seen.

New York & New England.

In Barnard and others, assignees, against Hart and others, trustees, the United States Circuit Court has decided that the mortgage known as the Berdell mortgage covered the lease and all leasehold interest in the Norwich & Worcester road which the Boston, Hartford & Erie Company acquired by its lease of that road. Both the trustees under the mortgage and the assignees in bankruptcy claim to hold the lease, although, by agreement between the parties, the trustees operated the road until the New York & New England Company was formed, and that company has worked it since. The Court now holds that the Berdell mortgage was intended to cover all property to be acquired after the date of execution, and the Norwich & Worcester lease, being executed after the mortgage, was included in it and is part of the property covered by it.

Michigan Central.

Reports are current that the new management has begun negotiations for the abrogation of several of the leases now held by the company and the substitution for them of new contracts which will be less burdensome to the lessee, and more in accordance with the present earning power of the lines.

Iowa Southern & Missouri Northern.

A company by this name has been incorporated in Iowa and has filed the necessary certificates. The object of the company is "the purchase, improvement by double track and otherwise, maintenance and operation of the main line of the Chicago & Southwestern Railway, extending from Washington, Iowa, to Leavenworth, Kansas; similar purchase of the Des Moines, Indianola & Missouri Railway, extending from Des Moines to Indianola; similar purchase of the Des Moines, Winterset & Southwestern Railway, extending from Somerset on the Des Moines, Indianola & Missouri Railway to Winterset; similar purchase of the Fort Leavenworth Railroad in the State of Kansas, and to purchase or lease bridges over the Missouri River which connect with or extend the lines of which this company shall become owner or lessee."

"Also to construct and extend the said Chicago & Southwestern Railway from the eastern terminus thereof at Washington, by way of Muscatine, to Davenport, and from its western terminus on the Missouri River to such point or points as may hereafter be determined in the State of Kansas."

Or, in short, to take and operate all the lines which the Chicago, Rock Island & Pacific Company now leases in Iowa and Missouri, and to make certain contemplated extensions. The incorporators are J. R. Cable, F. H. Griggs, E. E. Cook, J. Scott Richman, R. L. Drew and H. H. Hills. The office is to be in Davenport, Ia., and the capital stock is to be \$10,000,000. The incorporation may have been made by arrangement with the Rock Island Company, though if so it is hard to see why a new outlet from Washington to Muscatine and Davenport, the Rock Island already having a road there.

A Des Moines dispatch says that the transfer of the Des Moines, Indianola & Missouri and the Des Moines, Winterset & Southwestern roads to the new company was made Aug. 30.

European & North American.

For some time past this road has been in possession of the Trustee under the consolidated mortgage, and it was understood that the bondholders under the prior mortgages consented to the arrangement. Recently, however, Mr. J. Murray Kay, as Agent for the English holders of the first-mortgage bonds on the New Brunswick section of the line, began proceedings under that mortgage in the New Brunswick courts. The Court took the petition and, on Aug. 26, made an order appointing J. Murray Kay and E. R. Burpee Receivers of the road in New Brunswick, and also an injunction to prevent any equipment from being taken out of New Brunswick into Maine.

The Receivers took possession of their end of the line, from St. John, N. B., to St. Croix, 91 miles, Sept. 1, and the injunction went into effect the same day. Some inconvenience was caused at first, but an arrangement was made under which the Trustee, who still holds the 115 miles of the road in Maine, guaranteed the prompt return of all engines and cars, so that trains could be run through as usual.

Southern Railroad & Steamship Association.

A meeting of this association was held in Atlanta, Ga., Aug. 30, with a full attendance of delegates. It was resolved to continue the rates now in force until the October meeting.

It is said that there was also a discussion over the unsettled affairs of the old Atlanta pool, which existed before the formation of the present association, but no final settlement was arrived at.

Philadelphia & Reading.

In view of the heavy reduction in tolls and freight charges made necessary by the present condition of the coal market, this company has ordered a general reduction of salaries. The reduction will be on all below \$2,000 per year, 10 per cent.; from \$2,000 to \$5,000, 15 per cent.; from \$5,000 to \$10,000, 20 per cent.; over \$10,000, 30 per cent.

The arrangements for the reception and delivery of grain for export at Philadelphia are not completed as yet, and nothing is being done at present.

Railway Mail Service Compensation.

The Special Commission to examine into and report on the rates of compensation for railroad mail service, appointed under an act passed at the last session of Congress, held a preliminary meeting in Washington, Aug. 30. The Commission consists of Hon. Gardner G. Hubbard, of Boston, known as the advocate of the absorption of the telegraphs by the Government; Hon. Frank H. Palmer, of Chicago, formerly a member of Congress from Iowa, but now chief editor of the Chicago *Inter-Ocean*; and Hon. Daniel M. Fox, of Philadelphia, with Mr. George M. Bassett, of New York, as Secretary.

The first regular meeting of the Commission was held Sept. 2, when Mr. Isaac Hinkley, President of the Philadelphia, Wilmington & Baltimore, and Mr. F. B. Gowen, President of the Philadelphia & Reading, appeared and made statements as to the pay heretofore received for mail service and the cost to the companies of the service furnished.

Union Railroad, Transfer and Stock Yard.

A company by this name has been organized in Indianapolis to build a track connecting the various lines entering that city outside the city. The track is to begin at North Indianapolis, on the Indianapolis, Cincinnati & Lafayette, and to extend to the west to the Terre Haute & Indianapolis road, thence around the south side of the city, crossing and connecting with all the lines entering it until it reaches the Cleveland, Columbus, Cincinnati & Indianapolis at Brightwood. The road will be about 12 miles long, partly double track, and the company proposes to establish

Toledo & Maumee.

Central Pacific.

Colorado Central.

Pittsburgh & Lake Erie.

Covington, Columbus & Black Hills.

Manchester & Keene.

Memphis & St. Louis.

Washington, Cincinnati & St. Louis.

Surveys are also being made from Harrisonburg eastward to the Potomac. The eastern terminus is not yet decided on, though Alexandria is most favorably spoken of at present.

No arrangement has yet been made for the payment of the principal of the \$750,000 notes of this company, which matured Sept. 1. The interest was paid on that date as usual. The company received offers for sale \$1,000,000 of new bonds, the proceeds of which were to be used in paying the notes. Proceedings for the new bonds were to be received until Aug. 24, but no further announcement has been made, and it is understood that the bonds were not taken. The \$750,000 notes were issued to obtain the money required to enable the company to take possession of the road.

A force is now employed on this road putting the grade in order and laying down the ties, of which enough have been bought for the whole road. It is said that the rails are to be laid at once and that the Cincinnati, Lafayette & Chicago Company will work the road. It is 28 miles long, from the Illinois Central at Kaukahee, Ill., west by north to the Chicago & Alton at Gardner.

The track will be laid out on the branch from West Chazy, N. Y., northward to Rouse's Point. This branch is 14 miles long and will really be the main line, as the through trains will run over it direct to Rouse's Point, avoiding the detour now made by Moores's Junction and the use of the 12 miles of the Ogdensburg & Lake Champlain road from Moores's Junction to Rouse's Point. The older road from West Chazy to Moores's will be used as a branch. The new line will be ready for trains this week.

The committee of bondholders gave notice in Amsterdam Aug. 18, that the bondholders had not subscribed to the agreement to the amount (90 per cent.) fixed by the agreement of Aug. 13, 1875, and that that agreement could not be carried out. The committee has accordingly stopped the exchange of its certificates of deposit of bonds for certificates of conveyance to be used in payment for lands.

The work on this road is progressing favorably. The Racquet River bridge was begun last week. The ties and rails are being delivered at Yarmouth and Digby and will be on hand before the grading is done. The track is now laid from Yarmouth, N. S., northeast to Saulnierville, 35 miles, and is making steady progress.

The Maryland Circuit Court, by agreement between counsel on both sides, has entered a *pro forma* decree dismissing the complaint in the suit against this company. The case will be carried up to the Court of Appeals.

Western Maryland.

Indianapolis and Springfield.

Dutchess & Columbia.

13 miles, from Fishkill to Hopewell. 'A strip of land not exceeding 49½ feet in width, lying southeasterly of the center line of said company's right of way, as the same may be located, from the said point in the town of Fishkill, on the Hudson River, to a point at or near Hopewell, distant some 13 miles easterly from said point in the town of Fishkill; such strip being hereby reserved by the said party of the first part.'

"It has been said, in extenuation of this singular transaction, that the reservation was made on the understanding that the Boston, Hartford & Erie road was to operate the 12 miles

Alabama & Chattanooga.

Measuring the Pacific Railroads.

Wheeling & Lake Erie.

Boston, Clinton, Fitchburg & New Bedford.

Geneva, Ithaca & Athens.

in of Mrs. A. J. Packard, or Maiden Chumk, Pa., for \$60,000. In section from Ithaca to Sayre, Pa., 37 miles, formerly the Ithaca & Athens road, was sold under foreclosure of the second mortgage of the subject to the first mortgage of \$600,000; it was also bought by Mr. Packard for \$5,000. Mr. Packard, who acts for the Lehigh Valley Company, then requires possession of the road subject to a mortgage for \$600,000. It extends from the Pennsylvania & New York at Sayre, Pa., north to Ithaca and thence north by west to Geneva, and is 77 miles long. It was built mainly to secure the coal traffic from the Lehigh Valley to the New York Central.

A contract has been made with the Pennsylvania Steel Company for 1,000 tons of steel rails, which are to be laid on the Virginia & Tennessee Division.

A St. Louis dispatch says: "The Atlantic & Pacific Railroad Company has brought suit against the St. Louis, Kansas City & Northern Railroad Company for non-compliance with contract in the matter of pooling receipts for freights conveyed between this city and St. Joseph, Mo., made in September of last year. Two hundred thousand dollars damage is claimed."

The reported withdrawal of the Toledo, Wabash & Western trains from Quincy has given an impetus to the proposed construction of this road from Quincy, Ill., to Beardstown. The road can easily be so located as to furnish a line for the Toledo, Wabash & Western. A public meeting was held in Quincy in aid of the project recently, and committees appointed to take immediate action.

Work has been begun on the extension from East Davenport into the city of Davenport. A portion of the distance is covered by an old grade used some years ago when the trains of the company ran into the city on the Chicago, Rock Island & Pacific track. This old grade is now being put in order, having been much damaged by the weather.

Burlington, Cedar Rapids & Northern.

Old Colony.

Rochester & State Line.

Wisconsin Central

Eastern.

These Essex bonds were the only liabilities of the Eastern Company which were secured by mortgage on any part of the road. They will probably be exchanged for the bonds or certificates issued under the new general mortgage.

The extension from Herman, Neb., northward is now completed to Tekamah, seven miles beyond Herman and 47 miles from Omaha. By its completion the company secures a subsidy of \$40,000 in bonds of Burt County, Neb., voted some time since. The time fixed by the vote expired Sept. 1, so that the extension was completed just in time.

A special meeting of the stockholders was held in Guelph, Ont., Aug. 25, to receive the report of the committee appointed to negotiate a sale of the property to the Great Western Company. No report being ready the meeting was adjourned. It is said that the Great Western is not willing to give more than \$10,000 over the incumbrances on the road, which it now works under lease.

The Savannah (Ga.) *News* says: "The Supreme Court has decided the case of the State of Florida and Trustees of the Internal Improvement Fund *vs.* the Florida Railroad Company *et al.* The order made was in substance: That the judgment of the court below, so far as it related to the Florida Central Railroad Company, be reversed, and that the bill be dismissed without prejudice to the rights of persons who may be bona fide bondholders, if any such there be, and that the Florida Central Railroad, and all property appertaining thereto, be delivered to the Florida Central Railroad Company, and that the master in the case be given such reasonable time for the settlement of his accounts, not beyond the first day of November next, as the court may deem proper."

Nashua & Rochester.

The extra work claimed for was due to a change in the plan of construction of the road, chiefly in substituting solid concrete for trestle-work. A great deal of testimony is to be taken and the case will be a long one. An appeal will probably be taken to the Supreme Court in any event, whatever Judge Stanley's final decision may be.

The necessary papers have been filed with the State Comptroller of Texas to cover the construction of a branch or extension from Denison, Tex., southeast to Mineola, about 100 miles. Mineola is the terminus of a branch of the International and Great Northern road.

	Passenger.	Freight.
Mileage of locomotives.....	95,929	101
" cars.....	268,756	1,407
Average cars per train.....	4.6	
Cost of locomotives per train mile.....	30.29 cts.	23.67
" cars.....	4.45	1.71
Pounds of coal used per car mile.....	\$14	
Total cost of Machinery Department.....	\$16,969	\$33,413
" per car hauled one mile.....	6.28 cts.	2.37
Cost of fuel per mile.....		

The entire locomotive mileage, including switching work-train engines, was 204,478 miles. The cost of switch and work-train engines is charged one-third to passenger two-thirds to freight. The cost of air-brake repairs was 13 per cent. of all locomotive repairs; cost of Pullman car repairs 13.35 per cent. of all passenger repairs.

Receiver Lary applied to the New York Supreme Court, A. D. 30, for an injunction to restrain the National Trust Company from selling \$100,000 bonds of the company held as security for a claim of \$25,000. The Court granted a temporary injunction and an order to show cause why it should not be made permanent.

The Springfield (Mass.) *Republican* of Sept. 1 says: "local excitement of the week has been over the closing of city's new Southern railroad connection by the Phelps, who were unable to obtain its absolute control, and so have determined to break up the line by refusing to operate with the Valley and Longmeadow railroads, running independently the Connecticut Central road from Shaker Village into the monkey depot at Hartford, so that no trains now go out of Springfield. The directors of our seven miles of Longmeadow Road, holding the key to the line, desiring to maintain to city this competing Southern road, and having no assurance that the Phelps would not sell them out to the old New York road as they offered to do the Athol road on its completion have always sought alliance with the Valley interest, the controlling one in the line. The latter, operated by a trust

found itself paying too great rental for its leased roads, threw up its Longmeadow lease, and sought to make new terms with the Central, offering the Phelps, 1, to pro-rate; 2, to give all their road earned; 3, to pay \$12,000 a year; 4, to leave it to the Railroad Commissioners to say how the line should be run. The Phelps refused for a long while to do either; finally they agreed to pro-rate, provided they could have the Longmeadow road, and they requested the Valley managers to hire it for them for \$6,000; but the managers of the Valley road were advised that the Longmeadow directors had done negotiating with the Phelps, and so they (the Valley managers) hired the Longmeadow road for \$7,000 and taxes, and have now offered to sub-lease it to the Phelps for \$6,000, in order to keep the line running. These are the simple facts in the history, and they prove, 1, that the Longmeadow directors are not willing to surrender the full control of the line to the Phelps, and, 2, that the Phelps are determined to break up the line unless they can have it."

Galveston, Harrisburg & San Antonio.

Work is being pushed on this road between Seguin, Tex., and the Guadalupe River, where the tracklayers are actively employed. The iron is now arriving promptly and there is no further delay on that account. The bridges over Mill Creek and Rio Geronimo are being put up.

Houston & Texas Central.

This company has had two lines surveyed for an extension of the Waco Branch from Waco, Tex., northwest to Hill County. A section of 10 or 12 miles is to be finally located and work on the grading begun.

Texas & Pacific.

Seventeen of the new engines ordered have been delivered to the company. Regular trains now run between Sherman and Texarkana on the Transcontinental Division. Only mixed trains are run yet, and some complaint is made as to the slowness of these trains.

Georgia.

It is proposed to build a branch about 14 miles long, from Greensboro, Ga., southward to Long Shoals Factory. The railroad company and the owners of the factory are said to be negotiating on the matter.

Texas Land Grants.

The Texas Legislature has extended the time for the expiration of several land grants as follows: Sherman, Tyler & Henderson, one year for completion of 20 miles; Sherman, Wichita & Pan Handle, one year for the road from Sherman to Gainesville; Corpus Christi, San Diego & Rio Grande, two years; Texas & Mexican Pacific, two years; Tyler Tap, one year.

Anderson, Lebanon & St. Louis.

The statement that work on this road has been suspended on account of trouble between the company and the contractor is, we are informed, not correct. The contractor is in full accord with the company. Work has been suspended for a short time, but is soon to be resumed.

Little Rock, Mississippi River & Texas.

A large force is now employed rebuilding the line between Chicot, Ark., and Medford, where the last rise in the Mississippi washed it away at intervals for some 30 miles. The present line is to be repaired so as to carry the full business, and the engineers are still at work locating a more permanent one that shall be free from the danger of destruction at every high water. The last line surveyed for the Chicot & Pine Bluffs line of the road leaves the present road at Varner's and runs west of Bayou Mason to a point eight miles west of Arkansas City, where it joins the Monticello Branch of the road.

Surveys are also being made for the extension of the Monticello Branch westward.

Duxbury & Cohasset.

The towns of Duxbury, Marshfield and Scituate, Mass., which together hold a controlling interest in the stock of this company, are agitating the question of selling their stock to some parties who have made an offer for it. The road is now worked under contract by the Old Colony Company, and has not been profitable, a considerable balance being now due the Old Colony under the contract. It is 21 miles long, from Cohasset, Mass., to Kingston. It is said that the parties who offer to buy the stock intend, if they secure it, to work the road themselves and to extend it from Kingston to Middleboro, and to build branches to Nantasket Beach, to West Hingham and through Plympton and Carver to Tremont.

Massillon & Conhocton.

Work on this road is progressing well and the grading is nearly done. The line is from Conhocton, O., northward to Beach City, on the Cleveland, Tuscarawas Valley & Wheeling, a distance of about 36 miles.

Pittsburgh & Northwestern.

Three lines have been surveyed for this proposed road from Pittsburgh to Youngstown, O. The distance by the three lines varies from 69 to 76 miles, the maximum grade from 52 to 66 feet per mile and the estimated cost from \$1,150,000 to \$1,250,000. Its construction is now urged upon the people of Pittsburgh on the ground that it will be an independent line and will secure to the city a new line to Cleveland and other very advantageous connections. The Pittsburgh & Lake Erie, a rival project, is also urging its claims on the same grounds.

Delaware Shore.

Trains are now running regularly over this road, in connection with the West Jersey Railroad, with which it connects at Woodbury, N. J. The stations and distances from Woodbury are: Cooper, 10 miles; Prospect, 13; Pennsgrove, 20. Some additional stations are to be established soon.

Sioux City & Pembina.

The Dakota Southern Company has agreed to indorse the first mortgage bonds of this company to the amount of \$180,000. The proceeds are to be used in completing the extension from Portlandville, Ia., northward to Challope, which is now graded and ready for the iron. The road is worked by the Dakota Southern.

ANNUAL REPORTS.

Atlanta & West Point.

This company works a line from Atlanta, Ga., southwest to West Point, 87 miles, of which it owns 81 miles and leases the use of the remaining six, from Atlanta to East Point, from the Central Railroad Company of Georgia. The present report covers the year ending June 30, 1876.

The equipment owned consisted of 21 engines, of which no less than 13 are reported as "laid up;" 7 passenger, 4 baggage and 1 express car; 5 cab, 113 box, 18 stock, 23 platform, and 3 coal cars; 2 shanty cars.

The property is represented by the following capital account:

Stock (\$15,212 per mile).....	\$1,232,200 00
Bonds (\$1,025 per mile).....	850,000 00
Dividends unclaimed.....	650 00
Due agents and connecting roads.....	8,012 28
Profit and loss.....	98,285 37
Total (\$17,557 per mile).....	\$1,423,147 65

Which is an extremely light capital account, one of the smallest in the country indeed.

The work done, so far as reported, was as follows:

	1875-76.	1874-75.	Dec.	P. c.
Through passengers carried.....	13,709	.....	.....	.....
Local ".....	27,132	.....	.....	.....
Total passengers.....	40,841	44,738	3,897	8.7
Bales cotton carried.....	61,413	67,139	5,727	8.5
Tons grain and four.....	12,661	.....	.....	.....
" lard.....	1,822	.....	.....	.....
" coal.....	3,340	.....	.....	.....
" fertilizers.....	3,108	.....	.....	.....
Total tonnage of freight.....	55,860	68,020	3,760	4.7

In passenger business there was an increase of 15 per cent. in number of through passengers and of 12 per cent. in receipts, with a decrease of 14 per cent. in number of and 12 per cent. in receipts from local business.

The earnings for the year were as follows:

	1875-76.	1874-75.	Inc. or Dec.	P. c.
Passengers.....	\$99,211 50	\$101,093 77	Dec.	1.9
Freight.....	160,344 99	167,805 63	Dec.	4.4
Mail and express.....	16,677 24	17,167 12	Dec.	2.8
Miscellaneous.....	7,368 25	9,767 78	Dec.	25.4
Total.....	\$283,498 98	\$295,714 30	Dec.	4.1
Working and general expenses.....	162,280 51	172,012 94	Dec.	5.7
Taxes.....	4,624 91	.....	.....	.....
Rental Central and Georgia track.....	7,000 00	.....	.....	.....
New rails over ordinary wear.....	10,000 00	8,000 00	Inc.	25.0
Total.....	\$183,905 42	\$199,748 36	Dec.	8.1

Net earnings.....	\$99,693 56	\$101,965 56	Dec.	2.3
Gross earn. per mile.....	3,259 61	3,299 01	Dec.	4.1
Net earn. per mile.....	1,144 75	1,172 02	Dec.	2.3
Per cent. working expenses.....	57.21	58.17	Dec.	1.7
Per cent. all expenses.....	64.76	65.52	Dec.	1.2

The profit and loss account for the year was as follows:

Profit balance from previous year.....	\$91,456 03
Net earnings.....	99,693 56
Total.....	\$191,049 59
Interest account.....	86,510 22
Dividends, 7 per cent., on stock.....	86,254 00
Total.....	172,764 22
Balance at close of year.....	\$38,285 37

Being a gain of \$6,829.34 during the year. The decrease in revenue from freight was mostly on local cotton, the crop along the line having been poor. The crop in Alabama was good, but much of that which was properly tributary to this road was diverted to competing lines. The road-bed has been kept in good order. Increased renewals of iron were necessary on account of increased speed of passenger trains and the present rapid wear of the old light iron, of which 20 miles are still in the track. The Superintendent recommends the use of steel rails in renewals hereafter, on the ground of economy. The motive power and cars are in fair condition.

The Superintendent sees no prospect of any considerable increase of business, unless from the completion of a connection through Louisiana with the Texas system of roads.

Denver & Rio Grande.

The following figures for the year ending Dec. 31, 1875, are from a recently published statement. They cover only the Main Line from Denver, Col., southward to Pueblo, 120 miles. The Arkansas Valley Branch, from Pueblo to Canon City and Coal Bank, 43 miles, was operated during the year by the construction company, and the extension from Pueblo to El Moro was not completed until after the close of the year.

The equipment at the end of the year consisted of 13 engines and 4 snow plows; 12 passenger and 4 baggage, mail and express cars; 4 caboose, 10 stock, 76 box, 78 flat and 128 coal cars; 39 service cars.

The work done was as follows:

	1875.	1874.	Inc. or Dec.	P. c.
Passenger train mileage.....	116,880	100,406	Inc.	16.474
Freight ".....	167,289	168,265	Dec.	946 0.5
Service ".....	98,092	84,743	Inc.	13,349 15.5
Total train mileage.....	382,261	353,354	Inc.	28,877 8.3
Passengers carried.....	28,179	28,611	Dec.	7,432 2.6
Passenger mileage.....	1,822,342	2,318,370	Dec.	496,128 27.4
Tons freight carried.....	57,569	65,436	Inc.	2,533 4.4
Tonnage mileage.....	4,756,880	4,121,285	Inc.	625,595 15.4
Average train-load passengers, number.....	15%	23	Dec.	7%
Freight tons.....	28%	24%	Inc.	4

The earnings and expenses for the year were as follows:

	1875.	1874.	Inc. or Dec.	P. c.
Gross earnings.....	\$365,095 86	\$378,663 67	Dec.	13,567 81
Expenses.....	208,067 14	195,626 09	Inc.	12,441 06
Net earnings.....	\$155,028 72	\$182,437 58	Dec.	\$27,408 86
Gross earn. per mile.....	3,025 80	3,150 63	Dec.	124 73 4.0
Net ".....	1,291 91	1,520 31	Dec.	228 40 17.6
Per cent. of exps.....	67.30	57.74	Inc.	5.56 10.7

The road operated was the same for both years. The increase of expenses in 1875 was largely due to heavy wash-outs occurring along the line.

Louisville, Paducah & Southwestern.

This road extends from Louisville, Ky., south by west to Cecil Junction and thence west by south to Paducah, 225 miles, with a branch from Cecil Junction east to Elizabethtown, 6 miles, making 231 miles in all. It has been in the hands of a receiver for over a year and was recently sold under foreclosure of the first mortgages.

Receiver Dupont makes the following report for the period from May 21, 1875, to April 30, 1876, eleven months and ten days:

Earnings from passengers.....	\$99,492
Freight.....	167,136
Coal.....	124,773
Express, mails and miscellaneous.....	29,790
Total earnings (\$1,876 per mile).....	\$433,354
Expenses (88.32 per cent.).....	382,774
Net earnings (\$219 per mile).....	\$50,580
Rentals paid.....	33,936
Net balance.....	\$16,644

The extraordinary expenses, growing out of the want of sufficient rolling stock, and the incomplete condition of the property, etc., by so much reducing available net proceeds, have been charged to operating expenses, or to rentals, amounting to \$63,119.

To these extraordinary expenses \$63,119, add profit \$16,644, equal to \$79,764; and subtract taxes unpaid, \$20,364, leave \$59,399 net.

The Receiver's statement of assets and liabilities is as follows:

Due from agents.....	\$3,943
Due from other companies.....	4,336
Cash on hand in Kentucky National Bank.....	15,600
Supplies and materials on hand.....	21,290
Total assets.....	\$45,169
Due Louisville, Paducah & Southwestern Co.....	\$1,607
Due other companies and individuals.....	27,469
Total liabilities.....	29,076

Balance, being net profit for the year.....\$16,644

The road has been worked under many disadvantages. With a proper equipment and facilities for doing business, and with a fair development of coal business along the line, it is believed that the road may, in time, be made to earn a reasonable interest upon its cost.

LOCOMOTIVE RETURNS, MAY, 1876.

Master Mechanics of all American Railroads are invited to send us their monthly reports for this table.

NAME OF ROAD.	Number of Locomotives in service.	Number of miles run.	Mileage.		No. Miles run to		Average cost per freight car per mile, cents.	Average No. of freight cars handled.	Cost per Mile in Cents for						Av. cost of	
			Total.	Average per Mile.	Coal of Wood.	Kind of Oil.			Repairs.	Fuel.	Stores.	Miscellaneous.	Refrigerators, dynamo, and wages.	Total.	Coal per ton or bushel.	Wood per cord.
Allegheny Valley (River Division)*.....	139	42	89,574	2,133	79.70	22.15	18.70	1.104	4.51	3.50	0.48	.....	7.23	16.92	.....	.....
" (Low Grade Division)*.....	120	17	38,695	2,276	33.90	19.00	19.80	0.915	4.47	3.88	0.77	.....	6.91	16.03	.....	.....
Atlantic & Great West'n (1st & 2d Div.)..	228	82	195,610	2,385	44.28	17.99	.....	.....	3.65	4.97	0.55	0.75	6.28	16.30	2.03	3.90
" (Third & Fourth Div.).....	197	48	114,380	2,466	44.28	30.89	.....	.....	3.81	4.07	0.39	0.76	6.03	15.95	2.03	3.30
" (Mahoning Division).....	83	54	108,496	2,009	44.28	19.07	.....	.....	3.30	4.97	0.40	0.82	6.00	16.29	2.03	3.30
Cairo & Vincennes.....	187	11	26,036	2,276	44.10	15.50	.....	.....	4.18	3.54	0.33	.....	6.22	14.27	1.56	.....
Cameron & Atlantic.....	67	13	22,157	1,704	64.10	17.50	.....	.....	4.73	7.72	1.04	.....	5.06	18.55	4.92	.....
Cleve., Col., Cin. & Ind. (Col'bue Div.)..	188	58	172,429	2,972	47.29	64.20	33.70	.....	1.77	4.16	0.51	.....	7.06	13.52	1.75	3.60
" " (Indianapolis Div.).....	207	63	212,834	3,378	46.93	49.00	27.5	.....	3.62	4.31	0.54	.....	7.00	16.67	1.75	3.80
" " (Cincinnati Div.).....	130	30	80,044	2,668	38.04	25.25	.....	.....	4.20	5.07	0.51	.....	7.54	17.31	1.75	3.80
Cleveland & Pittsburgh*.....	199	75	155,635	2,076	50.25	21.76	16.40	0.919	2.74	2.94	0.56	2.89	7.14	16.27	1.85	2.12
Cleveland & Mahoning Valley.....	41	6	17,075	2,846	58.19	20.25	.....	.....	0.87	3.96	0.33	1.01	6.34	12.21	1.87	2.68
Del., Lacka. & West. (Bloomburg Div.)...	80	27	64,490	2,389	.....	27.28	.....	.....	5.46	.....	0.65	.....	6.23	12.35	.....	.....
Erie & Pittsburgh*.....	98	29	87,964	1,999	37.44	17.33	17.30	0.981	3.76	4.53	0.76	1.80	6.87	17.72	1.70	1.70
Hannibal & St. Joseph.....	296	83	124,875	2,554	44.00	23.60	.....	.....	3.90	3.60	0.3	.....	6.70	14.70	1.50	2.50
Houston & Texas Central.....	499	62	126,745	2,041	57.40	40.10	13.70	.....	5.80	8.20	0.70	.....	8.50	23.10	4.50	3.58
Jeffersonville, Madison & Indianapolis*	236	43	84,107	1,956	46.23	24.40	17.07	1.900	2.91	5.28	0.50	2.24	7.40	18.33	2.50	2.00
Kansas Pacific, Main Line.....	673	85	127,555	1,854	32.07	12.19	.....	.....	6.21	8.77	0.50	.....	7.29	22.77	2.75	3.35
" including all branches.....	915	94	179,875	1,910	33.09	12.51	.....	.....	5.86	8.72	0.40	.....	7.47	22.84	2.85	3.49
Kansas City, St. Jo. & Council Bluffs.....	875	26	63,878	2,534	53.30	24.70	16.40	.....	6.90	6.10	0.50	.....	7.20	21.50	2.50	2.50
Lake Shore & Mich. So. (Buff. Div.).....	.....	90	171,923	1,910	35.65	40.56	.....	.....	4.24	11.43	0.52	.....	6.35	22.56	4.00	5.00
" " (Erie Div.).....	113	.....	233,583	2,907	44.43	45.43	.....	.....	4.61	7.73	0.36	.....	5.87	18.59	3.25	5.43
" " (Toledo Div.).....	80	.....	169,890	1,926	38.93	51.75	.....	.....	4.04	8.80	0.43	.....	5.93	19.23	3.45	4.06
" " (Mich. So. Div.).....	209	.....	489,717	2,103	40.40	45.33	.....	.....	4.01	10.42	0.35	.....	6.44	21.00	4.25	4.63
Leavenworth, Lawrence & Galveston.....	204	18	24,470	1,359	54.30	37.40	.....	.....	7.40	6.40	0.26	.....	5.80	19.68	3.38	2.60
Little Rock & Fort Smith.....	.....	18	.....	.....	42.90	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Marquette, Houghton & Ontonagon.....	88	24	27.1	5,140	.....	19.45	.....	.....	3.76	14.68	0.69	.....	8.41	27.54	.....	.....
Missouri, Kansas & Texas.....	766	65	192,106	2,678	33.40	.....	14.00	1.699	4.70	5.80	0.40	.....	6.60	17.50	2.24	.....
New York & Oswego Railroad.....	323	24	40,341	1,951	33.25	15.00	.....	.....	5.00	15.40	0.50	.....	7.90	28.20	4.83	.....
Northern Central (Elmira & Canan. Div.)	147	17	116,398	2,474	33.25	21.74	.....	.....	6.53	8.93	0.64	.....	6.13	19.16	.....	.....
Pennsylvania (New York Division).....	125	132	312,996	2,371	38.45	10.92	.....	.....	8.20	12.50	1.20	.....	32.10	14.70	6.35	.....
" (Amboy Division).....	154	45	79,850	1,774	57.20	16.18	.....	.....	7.20	8.50	0.90	.....	16.60	4.70	6.34	.....
" (Belvidere Division).....	103	38	65,443	1,722	46.66	11.44	.....	.....	6.70	10.40	1.40	.....	18.50	4.70	6.35	.....
" (Philadelphia Division).....	191	199	528,881	2,058	29.83	13.70	.....	.....	6.50	5.90	0.80	.....	12.60	1.67	3.92	.....
" (Pitts'div.).....	131	108	327,216	3,030	32.74	30.49	.....	.....	8.20	5.10	0.70	.....	14.00	1.87	3.92	.....
" (Pitts'div. East End).....	69	160	160,314	2,323	24.23	11.05	.....	.....	13.70	6.80	1.00	.....	21.50	1.87	3.92	.....
" (Pitts'div. West End).....	131	115	315,311	2,606	36.06	13.89	.....	.....	3.20	4.60	0.80	.....	8.60	1.87	3.92	.....
" (Tyone Division).....	104	92	65,688	2,393	25.30	24.27	.....	.....	2.70	5.50	0.60	.....	9.80	1.87	3.92	.....
" (West Pennsylvania Div.).....	194	22	44,578	2,040	41.16	.....	.....	.....	9.40	4.50	0.40	.....	14.00	1.87	3.92	.....
" (Lewistown Division).....	1	2	4,895	2,445	43.36	15.67	.....	.....	1.90	5.10	0.30	.....	5.80	1.87	3.92	.....
" (Redford Division).....	57	3	4,136	3,048	32.88	23.81	.....	.....	5.90	9.20	1.00	.....	7.00	23.10	4.75	8.80
Philadelphia, Wilmington & Baltimore.....	80	167	477,247	2,093	57.75	12.19	.....	.....	3.62	3.35	0.88	1.88	6.61	16.04	1.53	1.63
Pitts., Ft. Wayne & Chi. (East'n Div.)*	371	105	426,611	2,807	43.02	16.47	16.30	0.991	3.43	4.48	0.42	1.90	6.43	16.72	1.91	1.91
" (Western Div.).....	290	113	351,100	3,107	43.48	19.46	.....	1.027	3.48	4.48	0.42	1.90	6.43	16.72	1.91	1.91
Pitts., Cin. & St. L. (Little Miami Div.)*	197	40	96,058	2,401	53.92	14.35	15.56	1.007	1.16	5.28	0.78	1.96	7.12	21.28	2.61	3.00
" (Pitts. & Col. Div.).....	224	90	285,813	2,787	32.31	15.57	18.49	1.260	8.89	4.31	0.85	2.27	6.92	23.24	1.30	3.00
St. Louis, I. M. & So. (Arkansas Div.)...	325	30	65,700	2,192	.....	36.30	18.30	.....	3.86	6.11	0.99	.....	8.82	17.38	.....	2.90
St. Louis & St. Louis (St. Louis Div.)...	300	.....	65,590	.....	50.30	.....	18.00	.....	4.30	2.60	0.40	.....	6.40	13.70	1.32	.....
" (Nashville Div.).....	146	.....	41,260	.....	50.30	.....	14.80	.....	5.90	3.40	0.40	.....	7.20	19.70	1.17	.....
" (Pitts'div.).....	115	.....	73,817	.....	50.30	.....	19.40	.....	7.64	4.94	0.83	.....	7.65	21.26	.....	.....
" (Vandalia Div.).....	155	.....	77,332	.....	35.10	21.00	.....	.....	3.20	11.10	0.30	.....	8.08	17.72	1.44	.....
Terre Haute & Ind. (Indianapolis Div.)...	128	19	38,049	1,879	45.24	27.07	17.85	.....	3.20	11.10	0.30	.....	4.93	14.40	.....	.....
West Jersey.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....